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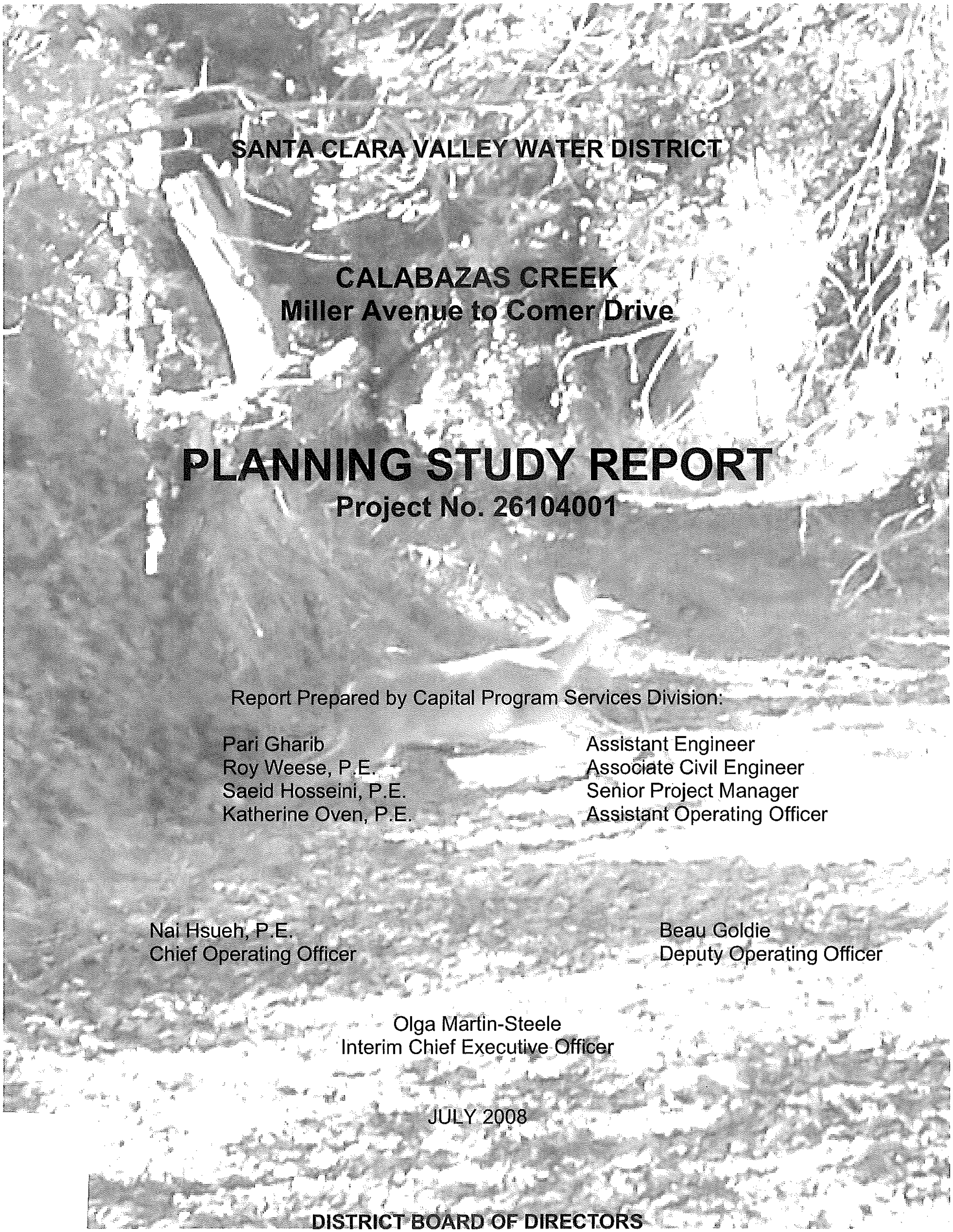

SANTA CLARA VALLEY WATER DISTRICT

CALABAZAS CREEK
Miller Avenue to Comer Drive

PLANNING STUDY REPORT
Project No. 26104001

Report Prepared by Capital Program Services Division:

Pari Gharib	Assistant Engineer
Roy Weese, P.E.	Associate Civil Engineer
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JULY 2008

This Planning Study Report has been prepared under the direction of the undersigned, who hereby certifies that he is a Registered Civil Engineer in the State of California.

L.A. WEESE
C 59727
EXP. 12-31-09

Roy Weese, RCE No. C59727, Expiration Date: 12/31/09

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EXECUTIVE SUMMARY

This report presents results of a planning study that was conducted as part of the Clean, Safe Creeks and Natural Flood Protection Program that the residents of the Santa Clara County approved in 2000. The study covers a 3.6-mile reach of the Calabazas Creek from Miller Avenue in Cupertino to Comer Drive in Saratoga and 2 tributaries, Rodeo Creek and Regnart Creek. The study area is shown in Figures 2-2 and 2-3 of the report.

The purpose of this study is to define the extent of the flooding and bank erosion problems in this area of the Calabazas watershed, evaluate alternative solutions and recommend a project that will protect the community from the 1-percent (100-year) flood and address erosion problems. It also explores opportunities for environmental enhancements for the District Board of Directors' consideration.

The planning study started in the summer of 2004. Extensive aerial and topographic surveys, flow measurements, sediment sampling, hydrologic analysis, geotechnical investigation, geomorphic data collection, ecological field investigation, right of way delineation, and many other types of technical analyses were conducted. Five public meetings were held in Saratoga and Cupertino from 2005 to 2007 to gather community input and report progress.

The study identified 2 locations on Calabazas Creek where the 1-percent flood would overtop channel banks and cause flooding damage. These locations were described in the report as

- Calabazas Site #3: A business parking lot upstream (west) of Saratoga-Sunnyvale Road,
- Calabazas Site #4: A residential area upstream of the Union Pacific Railroad (UPRR).

There is no flooding from the 1-percent flood on Regnart Creek or Rodeo Creek. The flood map is shown in Figure 2-5.

Several alternatives for flood protection were developed, including using detention swale, floodwall, enlarged culvert, and bypass channel, for the flooding sites.

The staff-recommended alternative for flood protection is to use a combination of flood detention and enlarged partial culvert replacement at Sunnyvale-Saratoga Road and an enlarged bridge replacement at the UPRR. This alternative was selected after careful evaluation following a set of natural-flood-protection criteria. The evaluation process was also discussed in public meetings.

The staff-recommended alternative also included 14 erosion sites in need of repair. Bank protection designs using natural and environmentally friendly materials were developed and described in the report.

The study also identified two environmental channel enhancement opportunities and recommended the Board to consider their implementation in the future:

- Comer Dam Modification
- Revegetation Planting (downstream of Prospect Road)

The Comer Dam Modification would include removing the upper portion of Comer Dam, just downstream of Comer Drive in Saratoga, and constructing a series of low, fish-friendly drop structures to re-establish an equilibrium channel profile. The revegetation planting would include revegetating 3800 feet of creek bank downstream of Prospect Road in San Jose. The study also examined restoring a section of the historic Calabazas Creek in Calabazas Park in Cupertino, but found the scheme infeasible due to extensive impact to existing heritage trees.

There is no need for permanent easement or fee title for the project. Temporary construction easements will be required from the City of Saratoga and UPRR. These right-of-way requirements are described in Chapter 6.

The construction cost of implementing the staff-recommended alternative is estimated to be $5.0 million, which would be funded by the Clean, Safe Creeks program. The cost of implementing both enhancement opportunities is $1.0 million. The current plan is to complete design by June 30, 2009 and start construction in 2010.

CHAPTER 1 - INTRODUCTION

1.1 PROJECT ORIGIN

In July of 2000, the Santa Clara Valley Water District's Board of Directors adopted the 15-year Clean, Safe Creeks and Natural Flood Protection Program (SCVWD, 2000). One of the proposed capital improvement projects in the Program was Calabazas Creek from Miller Avenue to Wardell Road, a length of 3.3 miles. The funding for this and other projects was approved by the voters in November 2000.

A primary reason this project was selected for the Clean, Safe Creeks and Natural Flood Protection Program was its flood protection benefits. The project was expected to protect 2,483 homes, businesses, and schools from the 1-percent flood, saving potential flood damages in excess of $30.9 million. The project would also provide bank protection upstream from Miller Avenue and improve the health of the stream.

1.2 PROJECT OBJECTIVES

As part of the Clean, Safe Creeks and Natural Flood Protection Program, the Santa Clara Valley Water District (District) initiated the Calabazas Creek Planning Study to provide flood protection, erosion control and channel restoration from Miller Avenue to Comer Drive in the summer of 2004.

The project objectives provide the fundamental basis for evaluating the project alternatives. The objectives of the Planning Study are as follows:

- Develop a plan for the entire watershed that presents alternatives and a recommendation for providing flood protection for all flows up to the 1-percent flood, erosion protection, and creek restoration for Calabazas Creek and its tributaries between Miller Avenue and Comer Drive.

- Provide flood protection to 2,483 homes, businesses and schools upstream of Miller Avenue from a 1-percent (100-year) flood, preventing potential damages of $30.9 million (1999 dollars).

- Identify opportunities for environmental enhancement such as stream restoration, as well as trails, parks, and open space, for the Board's consideration.

- Minimize the cost of maintenance.

1.3 RELEVANT BOARD GOVERNANCE POLICIES

This project is in accordance with the Santa Clara Valley Water District's (District's) Board Governance Policies. Specifically, the following District "Ends Policies" are implemented by this project:

Policy No. E-1
The mission of the District is a healthy, safe, and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective, and environmentally-sensitive manner. Accordingly, the Board of the District has adopted the directions to the BAOs (Board Appointed Officers) as to the intended results, organizational products, impacts, benefits, outcomes, recipients, and their relative worth (what good for which recipients at what costs).

Policy No. E-2
There is a healthy and safe environment for residents and visitors.
- *2.2. There is reduced potential for flood damages.*
- *2.2.1. There is natural flood protection that balances environmental quality, community benefit and protection from creek flooding in a cost effective manner. In providing flood protection, balance the following multiple objectives:*
    1. *Homes, schools, businesses, and transportation networks are protected from flooding and erosion.*
    2. *Ecological functions and processes are supported.*
    3. *Physical stream functions and processes are integrated.*
    4. *Maintenance requirements.*
    5. *Projects are integrated within the watershed as a whole.*
    6. *The quality and availability of water is protected.*
    7. *Cooperation with local agencies achieves mutually beneficial goals.*
    8. *Community benefits beyond flood protection.*
    9. *Life-cycle costs are minimized.*

Policy No. E-3
There is an enhanced quality of life in Santa Clara County through the protection and enhancement of watersheds, streams, and the natural resources therein.
3.2. Environmental enhancements are implemented to improve watersheds, streams, and the natural resources therein.
3.2.1 Potential environmental enhancement opportunities are identified to the Board.
3.2.2. Environmental enhancement opportunities are implemented as determined appropriate by the Board.

Policy No. E-4
There is a positive District image in the community which supports the carrying out of the District's mission.
4.1. There is capable District staff with knowledge and expertise in subject matter integral to the future of water resource management in Santa Clara County.
4.2. There is increased positive interaction with the community.
4.2.1 Increased access to opportunities for small and local businesses in providing services to the District.

CHAPTER 2 – STUDY BACKGROUND

2.1 WATERSHED DESCRIPTION

The entire Calabazas Creek watershed lies within the Northwest portion of Santa Clara County and is in North Central Zone as shown in "Figure 2-1, Watershed Boundaries". Calabazas Creek extends approximately 13.3 miles and has its headwaters on the east slopes of the Santa Cruz Mountains, which flows in a northeasterly direction to discharge into Guadalupe Slough, just north of Mountain View-Alviso Road. The watershed includes about 22 square miles of mountain and valley floor land and five major tributaries; Prospect Creek, Rodeo Creek, Regnart Creek, Junipero Serra Channel and El Camino Storm Drain.

Basin elevations range from sea level to about 2,000 feet above sea level in the Santa Cruz Mountains. Calabazas Creek is steep in the mountainous areas, and then flattens to a gentler slope as it crosses the valley floor. The mountainous areas are characteristically brushy woodlands. The valley floor areas are extensively urbanized.

The area has a generally mild climate. Temperatures range from an average high of 81 degrees during July to an average low of 49 degrees in January. Mean annual precipitation ranges from about 37 inches in the upper watershed to 16 inches on the lower valley floor. About 90 percent of the rainfall takes place in the 5 months, November through March. The steep nature of the upper portion of the watershed results in short duration, high intensity runoff hydrographs.

After each major runoff event, low flows continue in the stream for several weeks as water temporarily stored in the watershed seeps into the streams.

The upland portion of the watershed has experienced low density residential development. The relatively flat valley floor, on the other hand, has been extensively developed in recent years. Field and orchard lands have been transformed into residential subdivisions, shopping centers, and commercial areas. Some undeveloped orchard land does remain on the valley floor, including some lands bordering Calabazas Creek within the proposed project limits.

Prior to 1950, Calabazas Creek was aligned to flow into Saratoga Creek between El Camino Real and the Southern Pacific Railroad (which is now owned by the Union Pacific Railroad, UPRR) near Kifer Avenue. The creek was constructed on its present alignment as a creek separate from Saratoga Creek during the mid-1950s. A concrete lined channel exits from Highway 101 to upstream of Lawrence Expressway. Channel between Lawrence Expressway and Miller Avenue was intermittently constructed of gabion lining, concrete lining and natural soil exist. Upstream of Miller Avenue, the channel is mostly natural, except at road crossings.

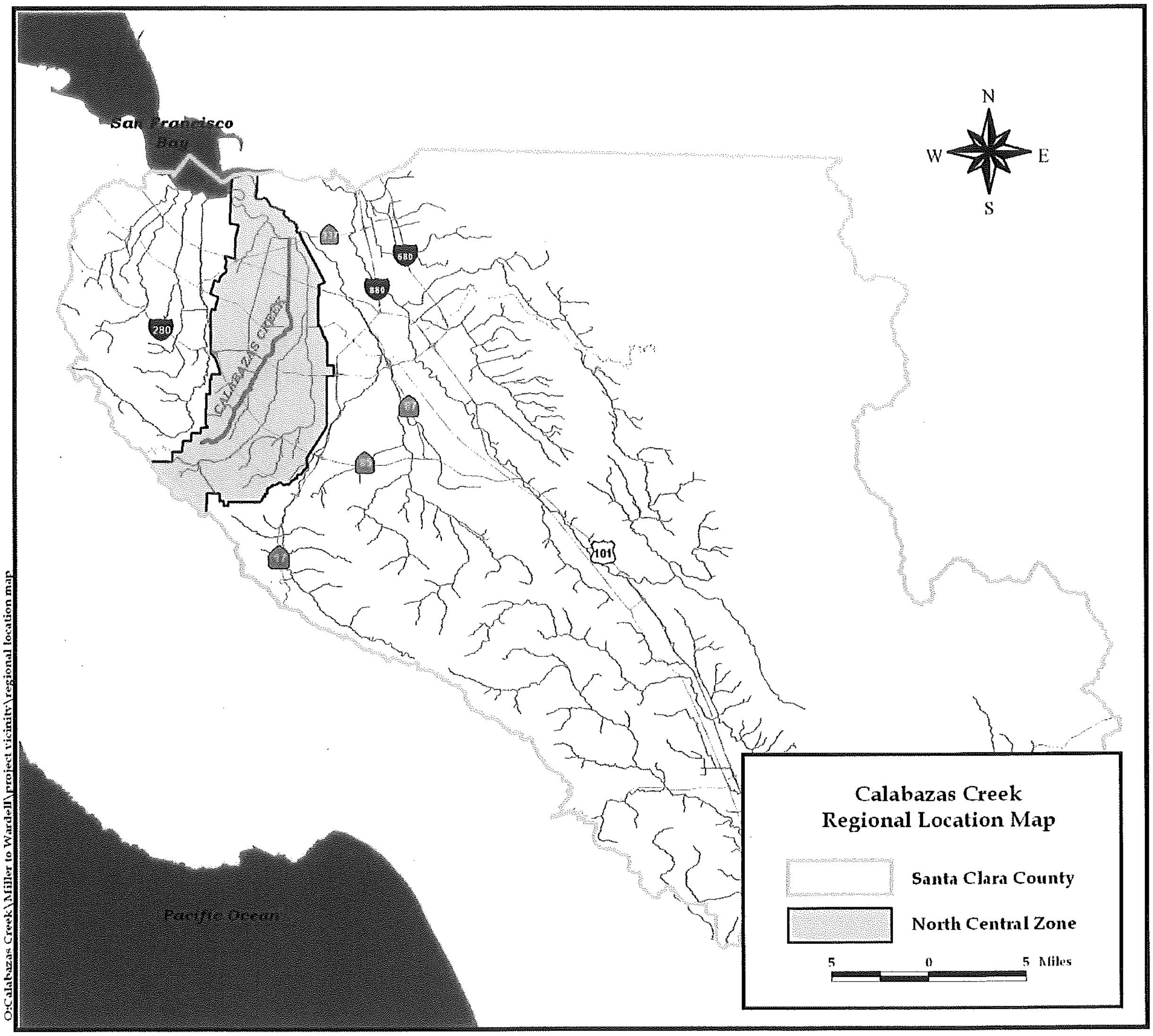


Figure 2-1: Watershed Boundaries

2.2 LOCATION AND STUDY LIMITS

The location of this Project is in the upper (southern) portion of the Calabazas Creek watershed, as shown in Figure 2-2. The study area covers Calabazas Creek and 3 tributaries, Prospect Creek, Rodeo Creek and Regnart Creek.

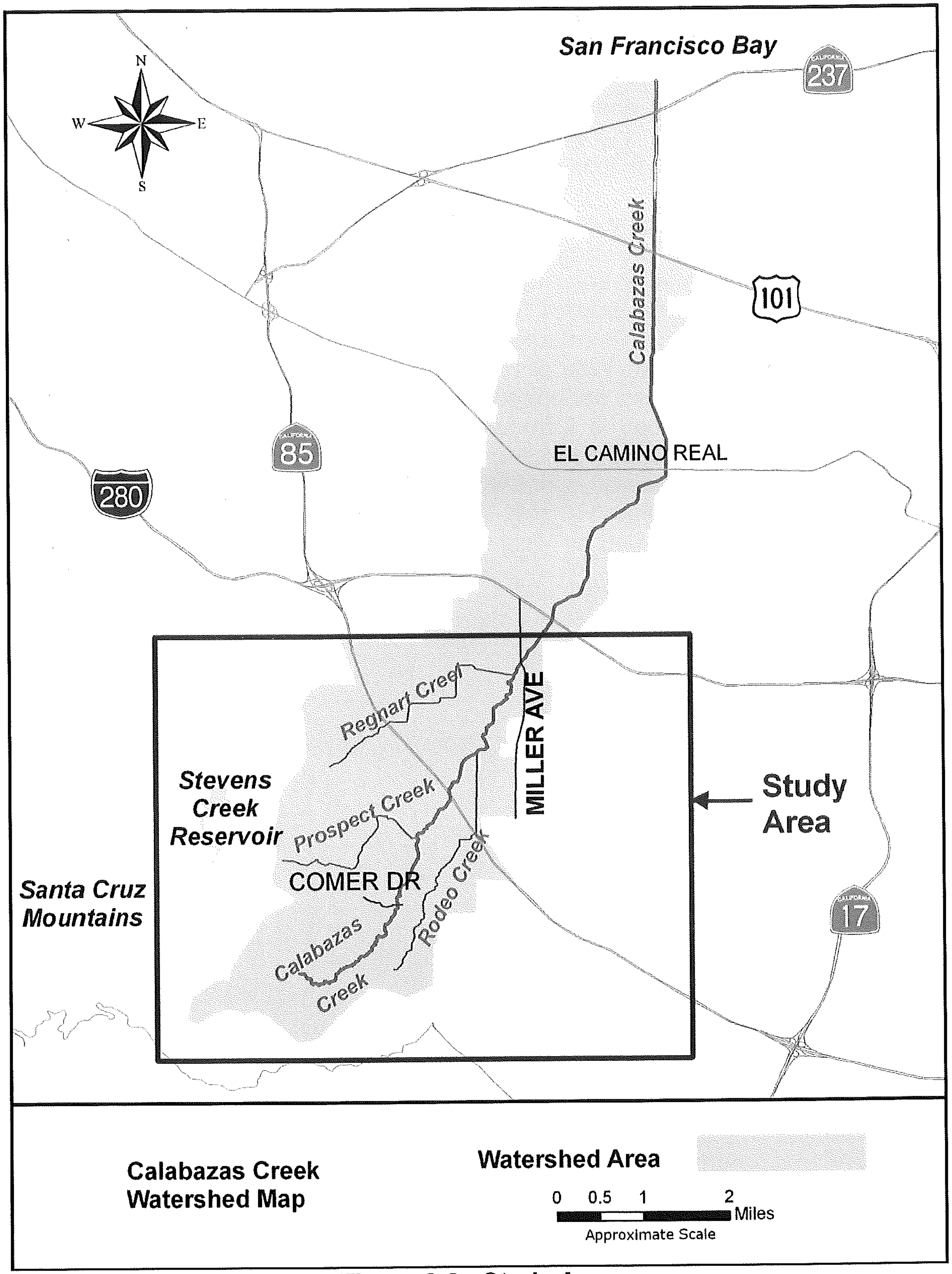


Figure 2-2: Study Area

Between Miller Avenue and Comer Drive, which is about 3.6 miles long, the Creek runs through the Cities of Saratoga, San Jose and Cupertino, the boundaries of which are delineated in Figure 2-3. Within this project area, the watershed is heavily urbanized.

The tributary Prospect Creek enters Calabazas Creek immediately downstream of Union Pacific Railroad (UPRR), Regnart Creek enters at Creekside Park about 1,000 ft upstream of Miller Avenue, and Rodeo Creek enters about 2,700 ft upstream of Bollinger Road. Hydraulic analyses were performed on Calabazas Creek and its 2 larger tributaries, Regnart and Rodeo Creeks. Prospect Creek was not studied because there was no known flooding or erosion problem on this creek.

The project limit originally defined in the Clean, Safe Creeks Program was from Miller Avenue to Wardell Road. The project plan outlined a more comprehensive evaluation of the entire Calabazas watershed to more effectively address local creek problems between Miller Avenue and Wardell Road, some of which are caused by conditions upstream of Wardell Road. Therefore, the project study area was extended to include the 0.4 mile segment between Wardell Road and Comer Drive. Hydraulic and sediment transport analyses were also performed to an extended limit from Miller Avenue to Padero Road. Padero Road is located 2,200 feet upstream of Comer Drive. This upstream reach was added to allow characterization of sediment inflow into the project reach. No work is considered upstream of Comer Drive except for minor step pool work extending approximately 170 feet upstream of Comer. Therefore, the current planning study limits are defined as Miller Avenue to Comer Drive.

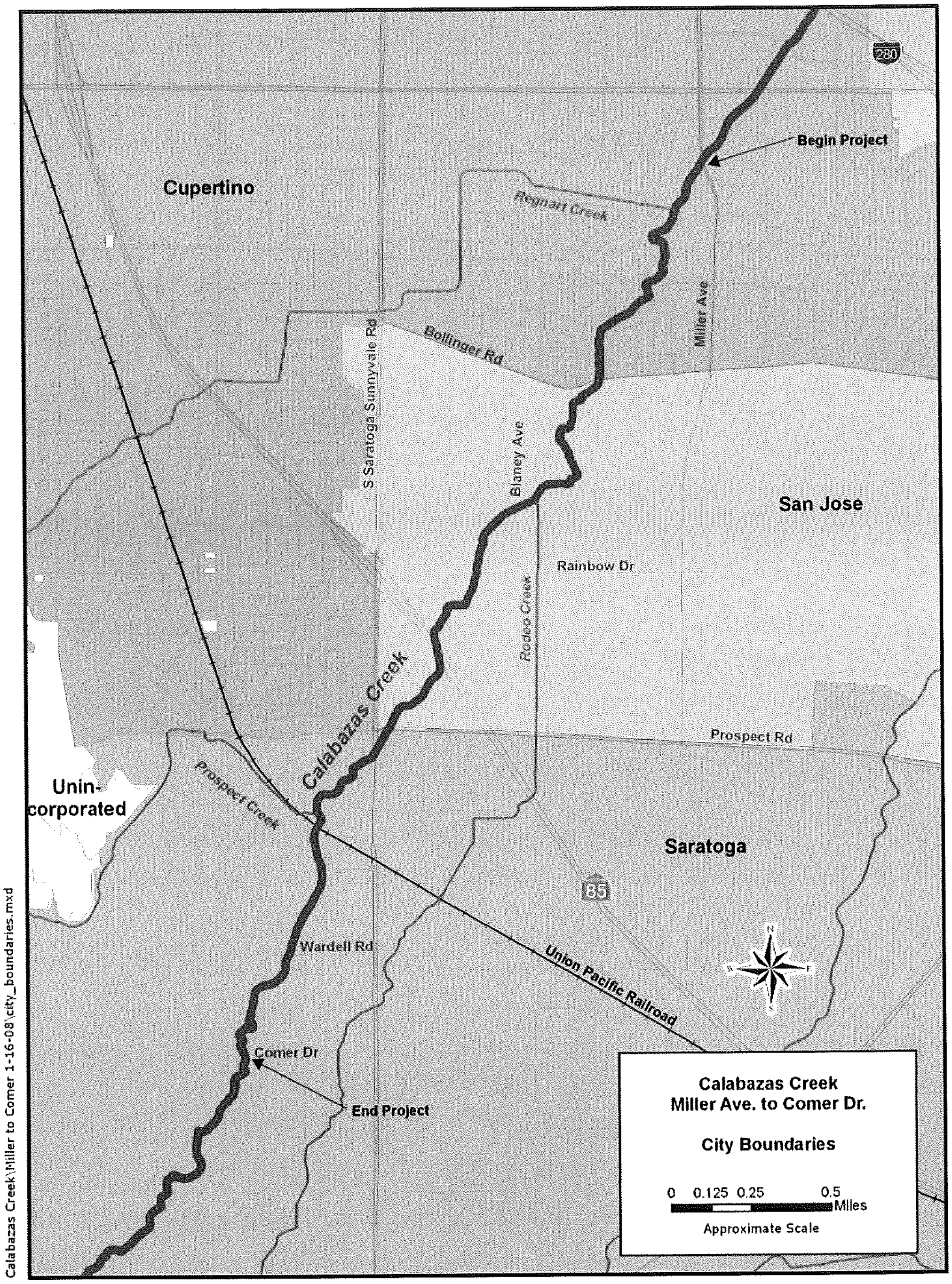


Figure 2-3: City Boundaries

2.3 FLOODING HISTORY

History of National Flood Insurance Program

Flooding is the most serious natural hazard facing the American people. Of the natural disasters in this country, 90 percent are flood-related. Floods kill people and destroy homes in many parts of the United States every year. Federal agencies estimate that an average of over 125 people die every year in the United States because of flooding, although losses vary widely from year to year. Property damage ranges into the billions each year, and has been rising in recent decades. The Flood Control Act of 1936 gave the US Army Corps of Engineers (Corps) the mission to provide flood protection to the entire nation.

Neither the Corps nor any other agency can prevent all flood damages, but there is an impressive record. During the 10 years from 1991 through 2000 the United States suffered $45 billion in property damage from floods. During that same period, however, Corps' flood damage reduction measures prevented more than $208 billion in damage - 82% of the damage that would have occurred if the protection were removed.

The National Flood Insurance Program (NFIP) was created by the Congress in 1968 to mitigate the effect on communities and individuals of property damage due to floods and flood-related hazards. The NFIP enabled property owners to purchase flood insurance at a reasonable rate. Such insurance is designed to reduce the escalating costs of property damage caused by floods and is generally unavailable from private sector insurance companies. The program is based on an agreement between local communities and the federal government that if a community will implement programs to reduce future flood risks, the federal government will make flood insurance available within the community as a financial protection against flood losses which do occur.

The NFIP has the following four objectives:

1. Transfer costs of flood losses from tax payers to property owners
2. Provide financial aid to floodplain residents and owners after floods
3. Guide development away from flood hazard areas
4. Require new and substantially remodeled buildings in ways to minimize or prevent flood damage.

Extensive public subsidies are required to make flood insurance affordable for owners of existing structures. This cost is offset by reduction in future disaster relief appropriations, which would result from requiring new construction to be less susceptible to flood damage. Community participation in NFIP and individual purchase of insurance were both voluntary, based on the 1968 Act. The Flood Disaster Protection Act of 1973 made flood insurance mandatory when "federally related financing" was involved in acquiring or developing property located in a defined flood hazard area. Federally related financing includes direct federal grants and loans and mortgage loans by financial institutions insured or regulated by federal agencies such as the Federal Reserve Bank and the Federal Deposit Insurance Corporation. Before property owners can obtain flood insurance, the local community (City or County) must join the program. Joining in the NFIP requires that those communities with designated flood hazard areas adopt and enforce floodplain management measures that will diminish the impact of future floods.

When the Community has joined the Program, property owners throughout the community can purchase subsidized insurance to cover structural and content losses.

The following table shows the maximum amount of insurance available as of 2008.

	EMERGENCY PROGRAM	REGULAR PROGRAM		
		Basic Insurance Limits	Additional Insurance Limits	Total Insurance Limits
BUILDING COVERAGE				
Single Family Dwelling	$ 35,000*	$50,000	$200,000	$250,000
2-4 Family Dwelling	$ 35,000*	$50,000	$200,000	$250,000
Other Residential	$ 100,000**	$150,000	$100,000	$250,000
Non-Residential	$ 100,000**	$150,000	$350,000	$500,000
CONTENTS COVERAGE				
Residential	$10,000	$20,000	$80,000	$100,000
Non-Residential	$100,000	$130,000	$370,000	$500,000

* In Alaska, Guam, Hawaii, and U.S. Virgin Island, the amount available is $ 50,000.
** In Alaska, Guam, Hawaii, and U.S. Virgin Island, the amount available is $ 150,000.

Table 2-1: Maximum FEMA Insurance Coverage

Table 2-2, "Annual Rates per $100 of Coverage" illustrates the 2008 Emergency Program rates for coverage.

	Building	Contents
Residential	0.76	0.96
Non-Residential	0.83	1.62

Table 2-2: Annual Rates per $100 of Coverage

For more information, see the National Flood Insurance Program website at:
http://www.fema.gov/business/nfip/

Flood history within the Project Limits

Flooding occurred upstream of Saratoga-Sunnyvale Road in 1998 due to the inadequate size of the existing culvert. Flows traveled 2,800 feet to the north (downstream) to the intersection of Saratoga-Sunnyvale Road and Hwy 85 according to the 1998 District flood report. Some flow may have also traveled easterly and entered the storm drains, causing additional flows in Rodeo Creek.

Flooding occurred upstream of the UPRR in 1955 because of debris accumulation at the bridge opening. Flooding occurred at this same location again in 1998 because of the undersized bridge opening. Flows from the 1998 event traveled southeasterly to Saratoga-Sunnyvale Road. Several residences upstream of the UPRR were also flooded by this 1998 flooding.

The 1998 flood also overflowed at the Bollinger Road Bridge and Miller Avenue Bridge and caused neighborhood street flooding. The Miller Avenue culvert has since been replaced in 1998, and the Bollinger Road Bridge was rebuilt in 2007 and 2008.

2.4 MAINTENANCE HISTORY

The District's Field Operation Unit has established the practice of inspecting Calabazas Creek every year and its tributaries every other year. Calabazas Creek within the entire project area (from Miller Avenue to Comer Drive) is inspected by a Field Operation Administrator (inspector) during a creek walk. If the inspector finds any major erosion sites or other problems, a work order is written and a maintenance crew will then provide the necessary repair work.

Because of the large volume of maintenance work on creeks throughout the county and the limited amount of maintenance funds, the Field Operation Administrator applies privatization criteria for what erosion sites would be considered "major" in light of the erosion sites throughout the county.

Tables 2-3, "Calabazas Creek – Historical Maintenance Work" presents a summary of maintenance work done from 1990-1998 to maintain flood conveyance capacity. This work included erosion control and sediment removal.

Location		**Erosion Control / Frequency**	**Sediment Removal Frequency**
From	**To**		
Miller Avenue	Rodeo Creek	Rock Replacement/ Once Per year	
Rodeo Creek	Prospect Creek	Rock, Miscellaneous/ Once in two years	Once in eight years
Prospect Creek	Comer Drive	Rock, Sack Concrete, and Miscellaneous/ Once per year	* Once in four years
* See the detailed discussion on Comer Debris Basin in Section 2.5 of this Report			

Table 2-3: Calabazas Creek - Historical Maintenance Work

The only maintenance work done on Calabazas Creek since 1998 was the installation of rock riprap to reduce bank erosion near Station 518+00 between Highway 85 and Prospect Road.

Regnart and Rodeo Creeks are inspected once every other year by a District Field Operation Administrator. Regnart Creek is inspected from the confluence with Calabazas Creek up to the UPRR. Rodeo Creek is inspected from the confluence with Calabazas Creek up to Saratoga-Sunnyvale Road.

Table 2-4, "Regnart Creek – Historical Maintenance Work" and Table 2-5, "Rodeo Creek – Historical Maintenance Work" summarize the maintenance work done from 1990-1998 to maintain flood conveyance capacity.

Location		Erosion Control / Frequency	Sediment Removal Frequency
From	To		
Calabazas Confluence	d/s De Anza Blvd	Once in three years	Once in 2-3 years

Table 2-4: Regnart Creek - Historical Maintenance Work

Location		Erosion Control / Frequency	Sediment Removal Frequency
From	To		
Calabazas Confluence	u/s Danridge Drive		Once in 3-4 years
Rainbow Drive	60 feet u/s	Once in ten years	

Table 2-5: Rodeo Creek - Historical Maintenance Work

2.5 PREVIOUS ENGINEERING STUDIES AND CONSTRUCTION PROJECTS

Calabazas Creek – Guadalupe Slough to Miller Avenue

The District engaged in a planning effort on Calabazas Creek during the mid 1980's in preparation for creek improvements from the San Francisco Bay up to Miller Avenue. On May 26, 1992, the Board approved the Engineer's Report and Environmental Impact Report (SCVWD, 1992). This 1992 Planning Study required levee raisings, floodwalls, concrete trapezoidal channel modifications and gabion installations to protect adjacent communities from creek over banking and flooding. Bridge modifications were a major part of the flood protection construction work identified by the 1992 Planning Study. Bridges at Moffet Park Drive, Old Mountain View-Alviso Road and Tasman Drive were flood proofed. A clear span bridge replaced the existing box culvert at Kifer Road. A new parallel box culvert was placed under the Union Pacific Railroad (UPRR); additional cells were constructed at Lochinvar Avenue, Homestead Road, and Pruneridge Avenue. The culvert at Miller Avenue was replaced with a clear span bridge.

The construction phases are shown in "Figure 2-4, Previous Calabazas Construction".

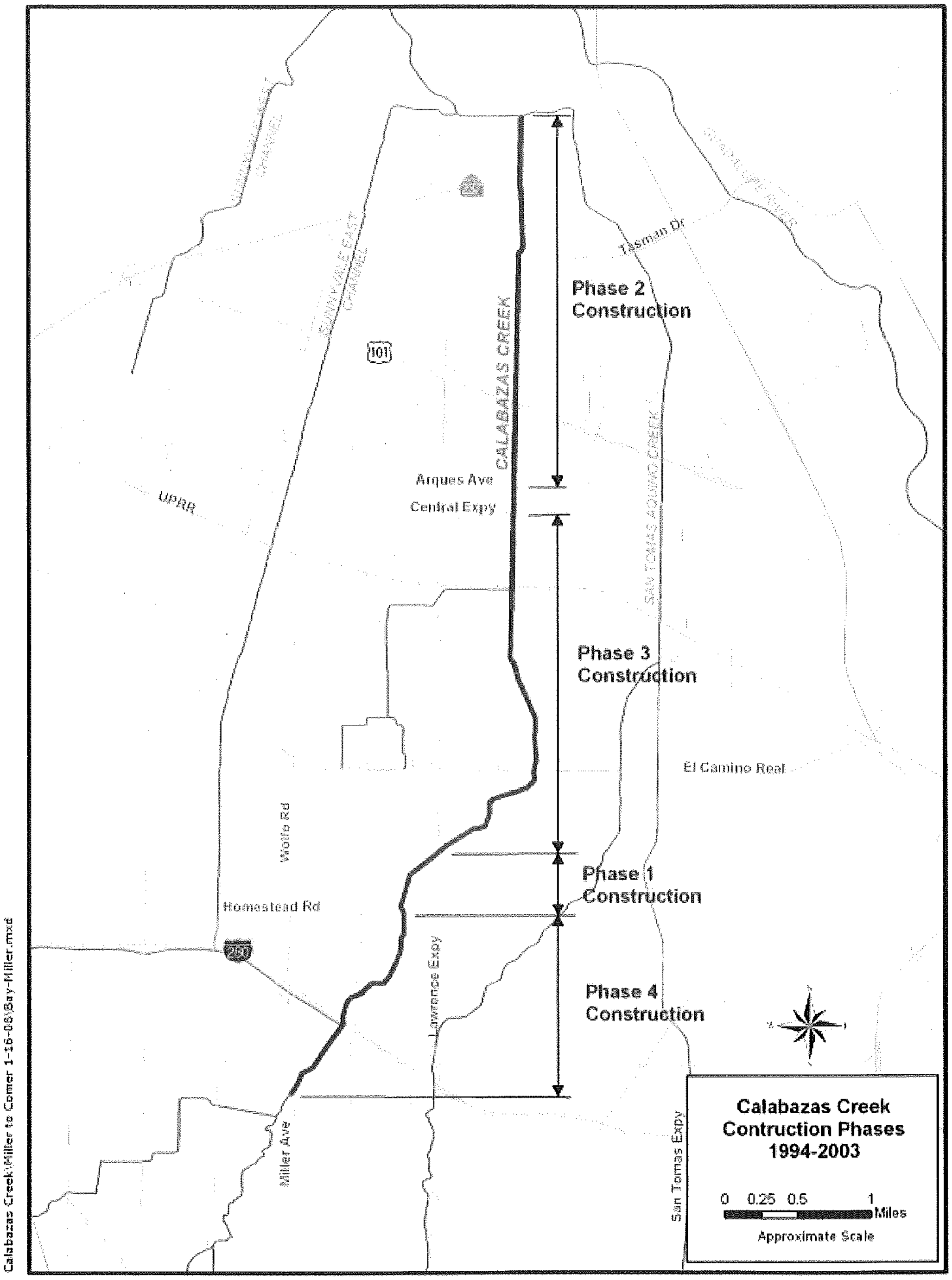


Figure 2-4: Previous Calabazas Construction

Additionally, the 1992 Planning Study required the re-vegetation of Calabazas Creek between Lawrence Expressway and Miller Avenue. All of the work proposed by the 1992 Planning Study was implemented between 1994 and 2003 as outlined in Table 2-6, "Previous Calabazas Construction" below:

REACH (PHASE*)	PROJECT NATURE	REACH LENGTH	CONSTRUCTION PERIOD	COSTS
Guadalupe Slough To Arques Avenue (Phase 2)	Installed floodwalls, earthen levees and maintenance ramps into the channel	13,300	May 1994 to Dec 1995	$6,140,000
Lawrence Expwy. To Homestead Rd. (Phase 1)	Enlarged Lochinvar and Homestead bridges, lined banks with gabions	2,700	Jun 1994 to Feb 1996	$3,186,000
Central Expwy. To Lawrence Expwy. (Phase 3)	Replaced Kifer Road, UPRR bridge and provided floodwalls		Dec 1994 to Nov 1996	$3,192,000
Homestead Rd to Miller Ave (Phase 4)	Enlarged Pruneridge, Tantau and Miller bridges; installed gabions on banks	8,400	Jun 1997 to Mar 1999	$7,091,000
Homestead Rd to Miller Ave	Revegetation of Phase 4 construction area	8,400	**Aug 1999 to Apr 2003	$574,000
Lawrence Expwy. To Homestead Rd.	Revegetation of Phase 1 construction area	2,700	**July 2000 to June 2003	$568,000

* The term "PHASE" (in column 1) denotes the planning phase. Note that planning phases are not named by chronological order of design & construction. This is because of various city agreements during the planning process.
** Revegetation construction time reflects monitoring work.

Table 2-6: Previous Calabazas Construction

Additional flood protection improvement work along Calabazas Creek from Central Expressway to El Camino Real was completed in December, 2007 in the Calabazas Creek Capacity Improvement Project. The project included the following elements: removal of maintenance ramps downstream of Central Expressway and upstream of Kifer Road, removal of a flow separation wall downstream of the UPRR Bridge, modifications of the channel invert downstream of the Machado Avenue Bridge and downstream and upstream of the El Camino Real Bridge, and relocation of a sanitary sewer line upstream of the El Camino Real Bridge.

This Engineer's Report is a sequel or continuation of the planning work published in the 1992 Planning Study. In addition, some other studies have been done on the Calabazas Creek. Below is a summary of the most recent studies done upstream of Miller Avenue.

Comer Debris Basin

The Comer Debris Basin is located on Calabazas Creek, downstream of Comer Drive Bridge. The District constructed the basin in 1973 as a sediment collection facility consisting of a 12-foot high dam located approximately 300 feet downstream of Comer Drive Bridge. The basin was created to collect excess sediment resulting from the quarry work occurring further upstream. The District Field Operation Unit historically excavated this excess sediment and hauled it off site. When sediment dropped out in the basin, the water flowing over the dam was also deprived of its normal supply of sediment. Consequently, it was noticed that after several years of operation that the downstream section between the dam and Union Pacific Railroad tracks degraded.

When the quarry work ceased in about 1992, sediment removal work was discontinued and the basin was allowed to fill. The filled basin resulted in a reduction of clearance between the channel bottom and Comer Drive from 10 feet to approximately 4 feet. After 1992, the basin is characterized by an exposed surface of coarse sediment and little vegetation.

In late 2001, the District evaluated the possibility of removing or eliminating the Comer Debris Basin. The District's West Valley Watershed Operations Division initiated a study at the request of the North Central Zone Advisory Committee and a member of the City of Saratoga's City Council. This study was performed by the District's consultant, Kennedy/Jenks Consultants, who published the *Comer Debris Basin Engineering Feasibility Study* (Kennnedy/Jenks, 2002).

Since 2003, the District began excavating sediment from under the Comer Drive bridge to provide greater capacity. The sediment was placed to the side of the channel downstream of Comer Road (every year) in where it could be carried downstream gradually by normal flows. This work allowed sediment to wash farther downstream, preventing the water from being sediment starved and allowing the invert to build back up downstream of the dam.

Interest in the removal of the Comer Dam still prevails among some members of the community and the City of Saratoga. Removal of the dam would also benefit the District by preventing the continual buildup of sediment under Comer Drive, which could be a flood hazard. The Comer Dam removal is classified as a potential channel enhancement in later sections of this Report. The District has incorporated this work in the CIP with a start date of 2014.

Abandoned (Old Bollinger Road) Bridge Removal

The Bollinger Bridge Mitigated Negative Declaration (SCVWD, 2003) and Engineer's Report (SCVWD, 2004) for the included the removal of the "abandoned old Bollinger Road bridge" (old bridge) located approximately 400 feet upstream of the Bollinger Road. The old bridge removal was done by the District work crews in 2005. This removal work began in June 2005. This removal work was followed by re-vegetation of the old bridge area, which was completed in December 2005. This re-vegetation work was performed to enhance habitat and provide mitigation for impacts associated with the Bollinger bridge construction.

Bollinger Road Bridge Replacement

The Reconstruction of Bollinger Road Bridge over Calabazas Creek Project was accomplished by a partnership between the City of Cupertino and the District. The partnership meets the combined goals of providing safe bicycle and pedestrian access, structural upgrading the bridge, and reducing flooding to nearby residences and infrastructure. Calabazas Creek has flooded three times at Bollinger Road since 1998. The District contributed approximately 79% and the City contributed the remaining 21% of the funding for the Bollinger Bridge Road project.

The City of Cupertino retained the engineering design consultant Winzler and Kelly in 2001. The City and the District have collaborated in finalizing the construction documents. As a component of the design, the District contracted with Multech Engineering to perform a physical model study of the proposed design, resulting in a number of modifications for more efficient energy management and erosion protection. The new Bollinger Road Bridge construction work began in the summer of 2007. The District is responsible for CEQA compliance, acquisition of regulatory permits, construction administration, and costs associated with culvert reconstruction and stream stability. The City is responsible for acquisition of local permits, utility considerations, and costs associated with widening the bridge and structural retrofit of the remaining culvert section. The Bollinger Road Bridge replacement construction contract was awarded on May 8, 2007. The construction work will be completed in October 2008.

2.6 HYDROLOGY / HYDRAULICS

The 1-Percent Flood Definition

The 1-percent flood is that flow of water from a drainage area that, on the average and over a long period of time, has a 1-percent chance (probability of 0.01) of being equaled or exceeded in any given year. It is sometimes referred to as the 100-year flood, but it should not be thought of as an event that occurs once in 100 years. It is possible that two repetitions of this flood flow could occur in a single year, or that a single event might not occur for over 100 years.

The 1-percent flood has a small risk of occurrence in a given year, but the risk is cumulative. When compared with the 30-year life of the average home loan, for example, the chance that such a flood will occur is quite large. During the 30-year loan period, the chance that a 1-percent flood will occur, or will be exceeded is about 26 percent.

Another relationship that requires explanation is that which exists between the "1-percent flood" and a "design flood." A design flood is any particular flood magnitude chosen for designing a flood protection project. A design flood could be the 1-percent flood or it could also be a flood of another frequency of occurrence. The 1-percent design flood is used by the District as its design standard for this project. Such a flood is also used by the Federal Emergency Management Agency as a minimum standard for its flood insurance program.

In general, floods are identified in terms of their peak flows and volumes. The peak flow rate is used to design flood protection channels and similar water structures. The flood volume is used to design overbank storage or flood retention and detention facilities.

Calabazas 1-Percent Flood Limits

The District flood protection project from Homestead Road to Miller Avenue eliminated 1-percent flooding concerns within the Miller Avenue area. The Bollinger Road project, which will be completed in 2008, will eliminate 1-percent flooding concerns within the Bollinger Road area.

The flood limits shown in “Figure 2-5, District 1-Percent Flood Limits” reflect the hydraulic analysis performed for this project in 2006 and 2007. These limits are reduced from the flood limits calculated by the District in the 1970’s. There are four primary reasons for this change as listed below:

1. Construction of Hwy 85
2. Updated hydrology
3. Recent District projects
4. Recent BMX Park work.

Per the Clean Safe Creeks & Natural Flood Protection Program document (July 25, 2000), the Calabazas Creek Project (Project) from Miller Avenue to Wardell Road would protect "2,483 homes, businesses and schools" avoiding potential flood damages of "$30.9 million". At the time, the number of parcels to be protected for this Project was based on the one-percent floodplain map developed by the District in 1970s.

As part of the nearly completed Planning Study for this Project, hydrology information and topographic information was updated, and detailed hydraulic modeling was conducted to determine the current flood threat in this part of the Calabazas Creek watershed. As a result of these efforts, staff has determined that the floodplain footprint for this reach of Calabazas Creek has been significantly reduced in size. See Appendix G for the 2007 Hydrology Report. The updated one-percent floodplain boundary encompasses 417 parcels.

The primary reason for the reduction in the extent of the one-percent floodplain is the construction of Highway 85, which bisects the study area for this Project. Calabazas Creek breakout flows have been identified at several locations to the south of Highway 85, and the highway now prevents these flows from flowing overland to areas further north. Additionally, the recent construction of the BMX Park by the City of San Jose along Calabazas Creek near Rainbow Drive, and the current reconstruction of the Bollinger Road Bridge, both provide flood protection to parcels in the area. The District worked closely with Caltrans during the Highway 85 design/construction process, and also coordinated with the City of San Jose with regards to the improvements at the BMX Park.

The new cost estimate for potential damages along Calabazas Creek between Miller Ave. and Wardell Rd. from a one-percent flood event is $11 million. This estimate is based on $26,250 in damages incurred per dwelling.

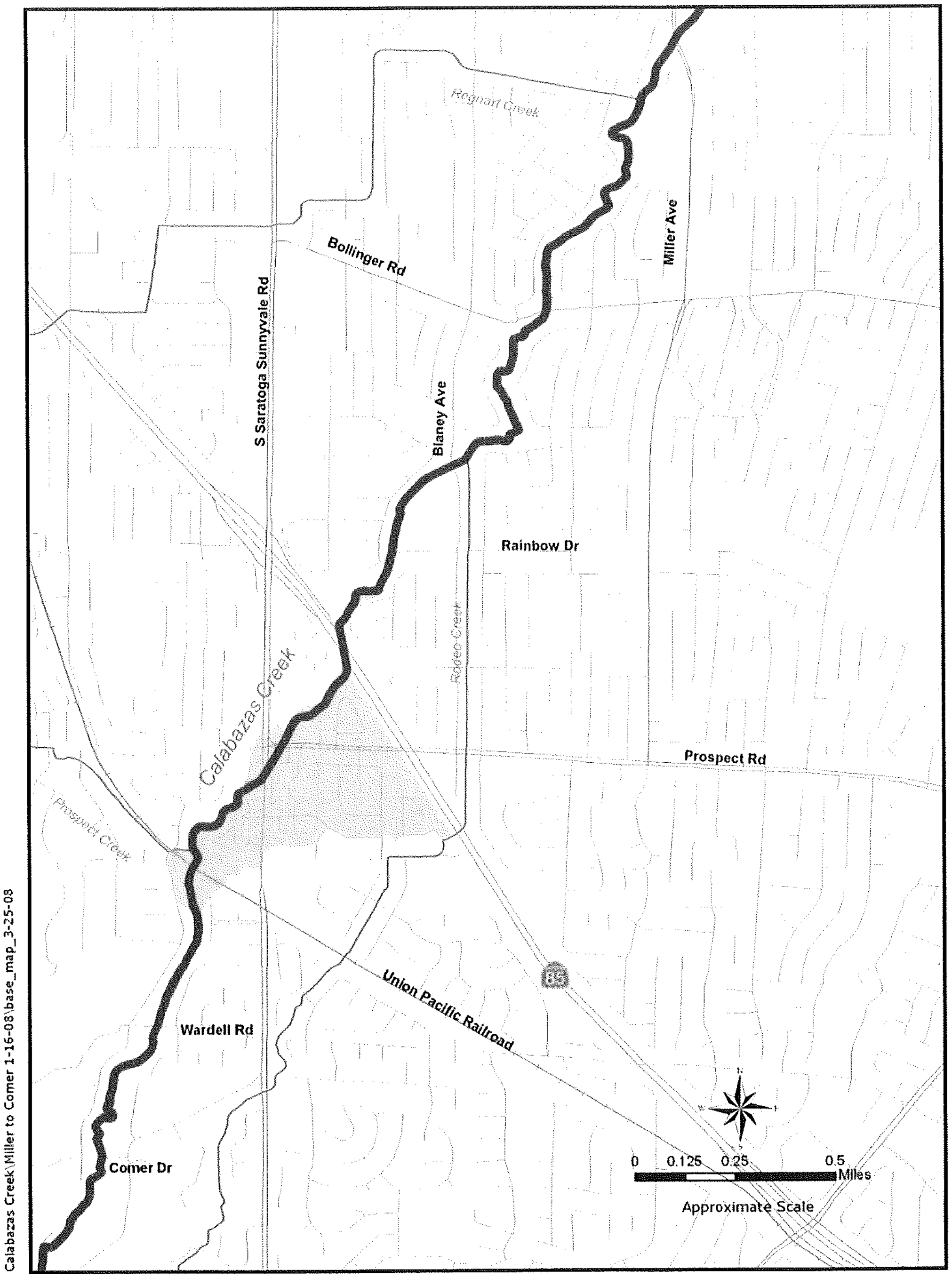


Figure 2-5: District 1-Percent Flood Limits

Hydrology for the Project Analysis

Calabazas Creek originates on the eastern slopes of the Santa Cruz Mountains, and drains a 21.8 square mile area of the Santa Clara Valley. The creek consists of 13.3 miles of channel that flows northeast into San Francisco Bay via Guadalupe Slough. From approximately elevation 2,000 feet, it falls steeply in the mountains, resulting in brief but high intensity runoff during most high-intensity storms.

The SCVWD Hydrology Unit staff prepared the hydrology report for the Project. The completed report is attached in Appendix G. The information is summarized as follows:

The Calabazas Creek Watershed originates at 1,920 feet above mean sea level in the Santa Cruz Mountains and flows north through the Cities of Saratoga, San Jose, Cupertino, Sunnyvale and Santa Clara. It meets San Tomas Aquino Creek at sea level near San Francisco Bay.

The 24-hour rain with an exceedance frequency of 1-percent in any year is used as the design storm to develop design flood flow. Unit hydrograph analyses were used to determine the flood hydrograph. The analysis was calibrated using the historical stream gage records in the watershed. Based on 2007 hydrology information, Table 2-7, “Calabazas Design Flows” was developed to show the design flows for Calabazas Creek at various catch points. Table 2-8 “Regnart Design Flows” shows the design flows for Regnart Creek at various catch points. Table 2-9, “Rodeo Design Flows” shows the design flows for Rodeo Creek at various catch points.

Hydraulics for Calabazas Creek

District Survey crews surveyed the existing channel between 2004 and 2005. Channel geometry was gathered for cross sections and field photos were used for “n” value computations. Most of the channel is natural.

The hydraulic model was run using steady flow with cross sections looking downstream. The water surface elevation at the downstream end is calculated from Bay to Miller Avenue hydraulic model (WSEL=201’) and used as a boundary condition for this base run.

Hydraulic flow rates for Calabazas Creek are summarized below in Table 2-7, “Calabazas Design Flows“ from the 2007 Hydrology Report.

GEOGRAPHIC LOCATIONS		STATIONS		FLOW RATES (cfs)	
FROM	TO	FROM	TO	10-YEAR	100-YR
U/S Miller	D/S Regnart Creek	400+86	409+30	1650	2650
	Regnart Creek	**tributary flow @ mouth**		**370**	**560**
U/S Regnart Creek	D/S Bollinger Ramp	409+30.1	445+00	1300	2100
D/S Bollinger Ramp	D/S Rodeo Creek	445+00.1	475+00	1200	2000
	Rodeo Creek	**tributary flow @ mouth**		**210**	**320**
U/S Rodeo Creek	4 ft Outfall D/S Rainbow	475+00.1	492+00	980	1600
4 ft Outfall D/S Rainbow	U-Frame U/S SR 85	492+00.1	512+00	920	1540
U-Frame U/S SR 85	Outfalls D/S Prospect Rd	512+00.1	525+00	860	1470
Outfalls D/S Prospect Rd	D/S Prospect Creek	525+00.1	546+25	800	1400
	Prospect Creek	**tributary flow @ mouth**		**170**	**290**
U/S Prospect Creek	U/S Comer Drive	546+25.1	593+82.9	650	1100

Table 2-7: Calabazas Design Flows

Hydraulics for Regnart and Rodeo Creeks

The District hired Sandis Engineering to survey Regnart and Rodeo Creek in the summer of 2006. Channel geometry was gathered for cross sections and field photos were used for "n" value computations. Most of the channel is earthen channel in both creeks.

The hydraulic model was run using steady flow with cross sections looking downstream. The water surface elevation at the downstream ends of both creeks with the water surface elevation calculated for Calabazas Creek at the confluence with Calabazas Creek.

Hydraulic flow rates for Regnart and Rodeo Creeks are summarized below in Table 2-8 and Table 2-9 from the 2007 Hydrology Report.

GEOGRAPHIC LOCATIONS		2007 Hydrology Peak Flow (cfs)	
FROM	TO	10-year	100-year
Calabazas confluence	Pacifica Drive	330	500
Pacifica Drive	Kim street	260	400

Table 2-8: Regnart Design Flows

GEOGRAPHIC LOCATIONS		2007 Hydrology Peak Flow (cfs)	
FROM	TO	10-year	100-year
Calabazas confluence	Dartmore Way	210	320
Dartmore Way	Prospect Road	200	310
Prospect Road	U/S of Prospect	200	300

Table 2-9: Rodeo Design Flows

Groundwater Conditions

Depth to groundwater was measured during and after our geotechnical field investigations. Additionally, six of the eighteen geotechnical borings were converted to piezometers, upon completion of drilling, for future groundwater measurement. A summary of groundwater depths is presented in Table 2-10, "Depth to Groundwater". Groundwater readings measured during drilling indicate the first encounter of free water on the auger or sampler. Where groundwater was measured during drilling, our field engineer took a second groundwater reading after the contractor completed the hole. Thereafter, our field engineer returned to each piezometer and took subsequent groundwater readings to plot the trend in groundwater fluctuation. The groundwater readings are presented in the table below:

Boring Name	Ground Elevation (feet)*	Depth to Groundwater (feet)						
		During Drilling	After Drilling	11/09/06	01/08/07	03/02/07	03/29/07	08/07/07
B-2	264.28	NE	NE	NE	NE	NE	NE	NE
B-7	280.91	20	18.5	23.4	26.9	15.1	27.9	NE
B-8	300.9	15.5	NM	36.5	27.9	27.3	37.2	NE
B-10	304.95	NE	NE	NE	NE	NM	NE	NE
B-12	306.55	NE	NE	NE	NE	NE	NE	NE
B-17	320.01	39	35.3	NA	NA	NA	NA	33.7

* Elevations and coordinates were surveyed by the District's Surveying unit and refer to NAVD1988 and NAD83, respectively.

NE = Not Encountered, NM = Not Measured, NA = Not Applicable

Table 2-10: Depth to Groundwater

It should be noted that fluctuations in the groundwater level could occur due to change in seasons, variations in rainfall, and other factors. Additional details on groundwater and other geotechnical parameters can be found in the Geotechnical Report (SCVWD, 2008).

2.7 ENVIRONMENTAL CONDITION

Overview

Calabazas Creek experienced extensive residential development during the 1950s and 1960s. This development pattern resulted in highly developed riparian zones and channels that have been extensively modified as a flood protection strategy (SCVWD, 2005). Calabazas Creek flattens as it crosses the valley floor through heavily urbanized areas. Major tributaries to Calabazas Creek include Prospect, Rodeo, and Regnart Creeks. Additional sources of water to Calabazas Creek include the El Camino Storm Drain (Main and East Branch), and the Junipero Serra Channel. The Project region supports a Mediterranean climate with cool, wet winters and warm, dry summers. The

Diablo mountain ranges protect the Project region from the hot summer weather of the Central Valley. In the summer, the Pacific Ocean provides a steady flow of cool, moist marine air, which holds temperatures at a moderate level. The Project vicinity is highly urbanized. Commercial and residential land uses surround the Project area. The vegetation/habitat classification presented herein is based on field observations.

The Project area supports the five vegetation/habitat types listed below and shown in "Figure 2.6, Habitat Types":

1. Riparian (including riparian woodland, instream wetland, and aquatic habitat),
2. Non-native grassland,
3. Ruderal,
4. Urban,
5. Urban park

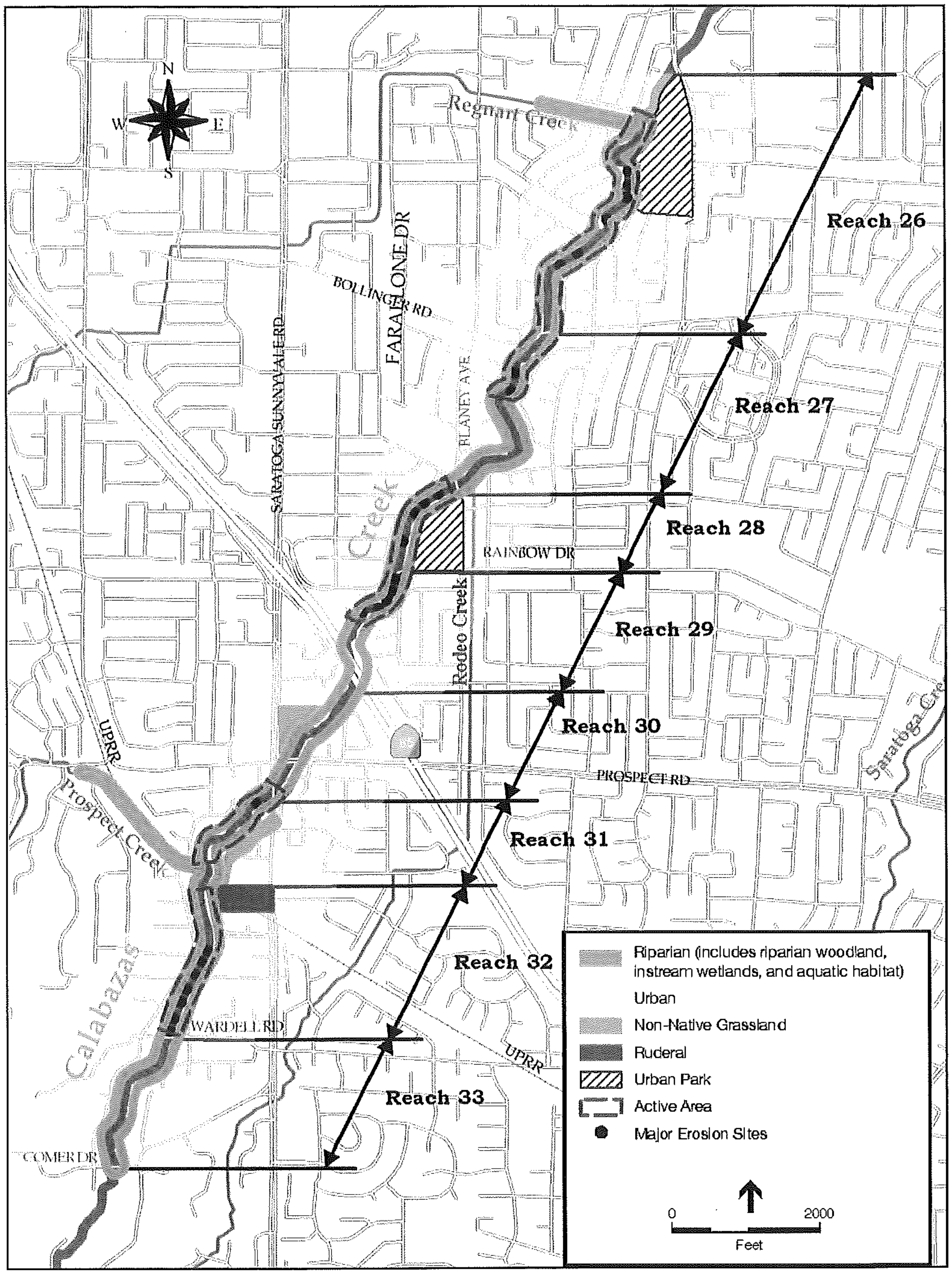


Figure 2-6: Habitat Types

Riparian Vegetation

Mixed riparian woodland dominates the Calabazas Creek corridor, with subtle differences between the upper and lower reaches of the Project area. Coast live oak (Quercus agrifolia) is the most prevalent species in all reaches but particularly dominates in the upper reaches of the Project area. Overstory associates include three willow species (Salix lasiolepis throughout the Project area with S. exigua and S. lucida ssp. lasiandra found occasionally); valley oak (Quercus lobata) and buckeye (Aesculus californica) throughout the Project area; and Fremont cottonwood (Populus fremontii) and white alder (Alnus rhombifolia) in the lower reaches of the Project area. Where riparian overstory is dense, the understory is generally sparse. Overall, the riparian understory is dominated by non-native species. Native shrubs occurring include coyote brush (Baccharis pilularis), California blackberry (Rubus ursinus), poison oak (Toxicodendron diversilobum), and occasional snowberry (Symphoricarpos albus ssp. laevigata). Non-native shrubs include French broom (Genista monspessulanus), Himalayan blackberry (Rubus discolor), and cotoneaster (Cotoneaster sp.). Herbaceous species occurring on the creek banks include common horsetail (Equisetum arvense), and a variety of non-native grasses, including giant reed (Arundo donax), smilo grass (Piptatherum miliaceum), ripgut brome (Bromus diandrus), common vetch (Vicia sativa ssp. nigra), and fumatory (Fumaria officinalis).

The instream wetlands vary widely in terms of vegetation density and somewhat in terms of composition, based on whether intermittent or perennial stream flows are present, the density of the overstory, and the elevation of the wetland in relation to the channel forming flow. Dominant species in these wetlands throughout the Project area are watercress (Nasturtium officinale), common horsetail, water bentgrass (Agrostis semiverticillata), and willow herb (Epilobium ciliatum). Other species commonly found include willow dock (Rumex salicifolius) and nutsedge (Cyperus eragrostis).

Aquatic habitat is discussed below along with fisheries resources.

Riparian Habitat

Riparian woodland habitats provide food, water, migration and dispersal corridors, breeding sites, and thermal cover for wildlife and can support many resident and migratory wildlife species (CDFG, 1999). Wooded stream edges serve as nesting sites and provide escape habitat for many species. Foliage, bark, and ground substrates provide a variety of foraging areas. Birds that forage for insects in riparian areas include Bewick's wren (Thryomanes bewickii), black phoebe (Sayornis nigricans), and black-headed grosbeak (Pheuticus melanocephalus). Bark-insect foraging birds also occur in this habitat and include acorn woodpecker (Melanerpes formicivorus), Nuttall's woodpecker (Picoides nuttalli), and white-breasted nuthatch (Sitta canadensis). Other bird species typically observed in riparian woodland habitats include the dark-eyed junco (Junco hyemalis), bushtit (Psaltriparus minimus), oak titmouse (Baeolophus inornatus), chestnut-backed chickadee (Poecile rufescens), and brown creeper (Certhia americana). Several of these species were observed foraging in Calabazas Creek's riparian woodlands during field surveys in April 2007.

Riparian woodlands also provide habitat for reptiles and amphibians, including the western toad (Bufo boreas), California newt (Taricha torosa), Pacific tree frog (Hyla regilla), and Pacific slender salamander (Batrachoseps attenuatus). Mammals such as the western harvest mouse (Reithrodontomys megalotis), deer mouse (Peromyscus maniculatus), western gray squirrel (Sciurus griseus), Virginia opossum (Didelphis marsupialis), and raccoon (Procyon lotor) utilize these habitats for nesting and foraging. Small rodents attract raptors such as red-shouldered hawk (Buteo lineatus) and red-tailed hawk (Buteo jamaicensis). Several black-tailed deer (Odocoileus hemionus columbianus), western gray squirrels, and raccoon tracks were observed during field surveys in April 2007.

Wildlife that depend on free (open) water, such as coyotes, foxes, raccoons, most rabbits, rodents and many species of birds, visit streams regularly. A number of amphibians require standing or flowing water for breeding, such as the western toad (Bufo boreas), Pacific tree frog (Pseudacris regilla) and the California red-legged frog (Rana aurora draytonii), a federally Threatened and California Species of Special Concern. Other species that require standing or flowing water include the western aquatic garter snake (Thamnophis couchii), red-winged blackbird (Agelaius phoeniceus), marsh wren (Cistothorus palustris), and the western pond turtle (Clemmys marmorata), a California Species of Special Concern. Freshwater emergent vegetation along streams and lakes also can provide some nesting and seasonal foraging opportunities and cover for water bird species such as mallards (Anas platyrhynchos), great blue herons (Ardea herodius), and great egrets (Casmerodius albus).

Non-native Grassland or Ruderal Vegetation

Non-native grassland and ruderal vegetation typically occur in areas where soils and native vegetation have been significantly disturbed at some point by grading, plowing, construction, or other land-clearing activities. There are two main areas of non-native annual grassland in the Project area. The first occurs in the proposed detention basin area in Reach 31, where an overflow bypass channel was constructed between the railroad and Saratoga-Sunnyvale Road. The second occurs on the northwest banks in Reach 30, a short distance downstream of Prospect Road.

Ruderal areas occur in some places at the top of bank between residential or light commercial yards and parking lots and the creek. A large ruderal area occurs along the railroad right of way between Saratoga-Sunnyvale Road and Calabazas Creek. These habitat types are dominated by non-native annual grasses and forbs, including wild oats (Avena barbata), annual ryegrass (Lolium multiflorum), ripgut brome, bristly ox-tongue (Picris echioides), poison hemlock (Conium maculatum), fennel (Foeniculum vulgare), and wild radish (Raphanus sativa).

Non-native Grassland or Ruderal Habitat

Annual grasslands in general support a small diversity of wildlife, but the adjacent riparian corridor and surrounding developed areas likely enhance the wildlife habitat elements of the few grasslands in the Project area. Reptiles typically found in grassland habitats include western fence lizard (Sceloporus occidentalis), western skink (Eumeces skiltonianus), and gopher snake (Pituophis catenifer). Common birds that use grasslands for nesting and foraging materials include western meadowlark (Sturnella neglecta), red-winged blackbird (Agelaius phoeniceus), and song sparrow (Melospiza melodia).

Urban or Urban Park Vegetation

These areas generally support no native vegetation and land cover is dominated by roads, buildings, other manmade structures, and landscaping. The level of vegetation and soil disturbance is so high in most developed areas that, in the absence of landscaping, only ruderal vegetation is expected to occur in areas not landscaped, paved, or covered with buildings. Developed areas occur directly adjacent to the Calabazas Creek corridor throughout the Project area. There are also two city parks adjacent to riparian corridor that provide large expanses of turfgrass as well as mature trees.

Urban or Urban Park Habitat

Developed areas generally support a low diversity of wildlife, however, those situated directly adjacent to riparian corridors can provide additional habitat for birds and small mammals when well landscaped. Birds associated with this suburban riparian habitat include black phoebe, yellow-rumped warbler (Dendroica coronata), bushtit (Psaltriparus minimus), and dark-eyed junco. Common mammals are black-tailed deer, raccoon, and western gray squirrel. Gopher snakes and western fence lizards are also found here.

Non-native Plants Summary

Several ornamental plants have spread into the right of way from nearby backyards. Additionally, some residents have sought to beautify the right of way adjoining their property by planting and caring for nonnative plants. Several fruit and nut trees have been introduced along the creek, reflecting past orchard cultivation; the most prevalent of these are almond and black walnut.

The lower reaches of Calabazas Creek, between Miller Avenue and Prospect Road, have a predominately non-native understory. The majority of non-native species are common European, South African and South American grass species such as kikuyu grass (Pennisetum clandestinum) and ripgut grass (Bromus diandrus). There are also three aggressive non-native species found within the lower reaches, acacia (Acacia baileyana), giant reed (Arundo donax) and English ivy (Hedera helix). The acacia and giant reed exist in mostly isolated pockets but the ivy is present throughout.

The upper reaches of Calabazas Creek, between Prospect Road and the Comer Debris Basin, has non-native plants mostly in the areas adjacent to the Union Pacific Railroad tracks. These areas are dominated by non-native grasses, mainly ripgut grass. The vegetation in the swale area adjacent to the creek between Saratoga-Sunnyvale Road and the UPRR tracks is also dominated by ripgut grass.

Aquatic Habitat and Fisheries

From Miller Avenue upstream to Bollinger Road, the Calabazas Creek channel consists of a regular, nearly trapezoidal cross section of earth-lined banks and ruderal vegetation forming little canopy. From Bollinger Road upstream to Miller Avenue and beyond, the channel shape of Calabazas Creek is more natural with meanders, increasing riparian vegetation, and increasing canopy cover. An approximately 1,500-ft long high-flow bypass channel has been constructed upstream of Saratoga-Sunnyvale Road. Throughout most of the Project area, substrate conditions generally consist of fine gravels and sand. Pool development is typically limited to shallow, lateral-pocket pools against riprap bends. In-stream cover is limited, consisting of occasional boulder or broken concrete rip-rap and some smaller diameter woody debris.

Surface water flow in the Calabazas Creek system is derived from a variety of sources. Local watershed yield produces some level of mostly intermittent flow. Significant winter storms result in continuous flow between the headwaters and the Bay, but during substantial dry periods, the stream may revert to intermittent conditions even during the wet season (Abel, 2003). Upstream of Saratoga-Sunnyvale Road and the UPRR track crossing, the creek is typically dry by late spring. Downstream, however, surface flows are maintained on essentially a year-round basis due to releases of imported water from the SCVWD's Stevens Creek Pipeline into the channel for percolation and groundwater recharge.

Numerous partial or complete barriers to fish passage have been identified in Calabazas Creek (Abel, 2003). The most significant of these barriers, an approximately 8 ft. vertical drop of armored concrete culvert and abutment under the Bollinger Road Bridge, is scheduled to be removed in 2008. A similar vertical condition exists at the Comer Debris Basin drop structure where the grade control and debris dam consists of an approximately 15-foot sloping drop with staggered energy dissipation ramparts formed in the face of the structure (Abel, 2003). Although the planned removal of the Bollinger Road barrier will be completed before implementation of the proposed Project, other partial barriers, such as shallow water flows prevent fish movement into and out of the Project area during most of the year.

SCVWD conducted fish surveys of Calabazas Creek between Miller Avenue and Mt. Eden Road (located upstream of the Comer Debris Basin) in December 2002 (Abel, 2003). A total of approximately 2,800 feet of stream were sampled. Despite thorough survey coverage in sampled reaches, very few fish were encountered. A total of twelve prickly sculpins (Cottus asper), three mosquitofish (Gambusia affinis), and one goldfish (Carassius auratus) were captured. While the sculpin is a native species, the other two observed species are introduced. Two non-native bullfrog (Rana catesbiana) tadpoles were also found. Similar to previous fish surveys cited in Abel (2003), no steelhead were observed during the 2002 surveys.

The fisheries functions and values map prepared for the District's Stream Maintenance Program EIR characterizes the reach of creek covered by this project as either "fish scarce" or "mixed native/introduced." Because of the lack of adequate fish habitat and lack of fish presence, the project will not include fish ladders, low flow channels or other features designed for supporting fish migration within the project limits.

Land Use

One area of particular interest within the lower reaches is the recently constructed bicycle motocross (BMX) track at City of San Jose's Calabazas Park. The BMX Park construction work began in December, 2006 and was completed in the spring of 2007. A makeshift BMX track existed before the City's work in early 2007, so this area had the same land use for many years.

The BMX area is mostly bare soil with Coast Live oaks, California buckeye and valley oak (Quercus lobata) along the banks of the historic channel that runs through the area. According to a resident interviewed, the historic channel was part of the main creek channel until the Army Corp of Engineers implemented a project on the creek and caused it to become disconnected. Although the channel is disconnected, this area contributes sediment to the creek from surface erosion reducing overall water quality.

There is an overflow channel adjacent to the creek between the Union Pacific Railroad Bridge and Saratoga-Sunnyvale Road. The swale also borders a neighborhood of townhomes at the top of bank. During the site visit there was a small amount water present in the center of the channel. This water was likely due to the rainfall the previous evening. The overflow channel connects to the creek in three places, an inflow near the railroad bridge, another inflow approximately 200 feet downstream of the bridge, and an outflow near Saratoga-Sunnyvale Road. This overflow channel flows as part of the Calabazas system during storm events adding additional water conveyance and capacity. The swale captures surface flows from the adjacent townhomes. The residences likely supply water to the overflow channel area during the summer months through irrigation and other non-specific runoff.

Identified Plants & Wildlife

The following tables list plant and wildlife species observed by ESA biologists during site visits on February 15 and April 16, 17, 18, and 24 of 2007.

pumpkin, squash). Clays in the vicinity of Lawrence were used for indigenous pigment. (Martin, 1854; Sherrebeck, 1854)

1840s: Most of the watershed above El Camino Real (~100-foot contour) was part of the of the extensive Rancho Quito land grant.

1880s: Agriculture expanded in the watershed, with hay and smaller areas of vineyards and orchards of prunes, olives, pears, and apples. Three small dams were constructed on the creek at the Farr property to supply water to a tank and to drive a grape crusher. (McArthur and Fuller, 1975)

1876, 1887: Regnart Creek is shown as spreading out just before Saratoga-Mountain View Road, rather than functioning as a direct tributary. (Baltzer, 1969; McArthur and Fuller, 1975; Thompson and West [1876], 1973)

Circa 1900: The Calabazas Creek ditch drained waters from the lower alluvial plain directly into Guadalupe Slough by that time, in a channel still disconnected from the upper, natural Calabazas Creek channel. The ditch initially jogged west 250 meters at present-day Highway 237 and then flowed straight into the highly sinuous portion of Guadalupe Slough that connected to Guadalupe River at the town of Alviso. That section of Guadalupe Slough was removed in the early twentieth century when the marshes in the vicinity were converted to salt evaporators and Guadalupe River was fully diverted into Alviso Slough. Flows from Calabazas Creek and the other West Valley Watersheds were also diverted around the salt evaporators into Alviso Slough for a number of decades, until being redirected to the present Guadalupe Slough outlet (Saah, 1994; United States Army Map Service (AMS), 1947).

The most downstream reach of Calabazas Creek between El Camino Real and Guadalupe Slough was relocated by farmers along straight property lines in the late 1800s and has been relocated or modified three times since then (Santa Clara Basin Watershed Management Initiative (SCBWMI), 2003c). In 1958, the District realigned the creek to its original outfall in Guadalupe Slough.

There are no known archeological sites within the project area. Because Calabazas Creek was likely located within the same vicinity of its present location, it's very possible that indigenous populations lived nearby at different times over the centuries. The contract documents will require that earthmoving activities be monitored by a qualified archaeologist in those areas where possibly significant sites have been identified. The archaeologist would then examine any exposed cultural materials and make appropriate recommendations. Thus, the project will comply with the National Historic Preservation Act.

CHAPTER 3 – PROBLEM DEFINITION

When the District's Problem Definition / Refined Objectives Report (SCVWD, 2007) for Calabazas Creek was first published in 2006, hydraulic analyses showed that during a 1% flood the floodwater would breakout from 4 locations. These 4 breakout points are shown in Figure 3-1, "Calabazas Flood Breakout Points". Since 2006, several changes to the creek have taken place. This chapter will provide a more detailed description of the existing flooding and bank erosion conditions of the Calabazas watershed.

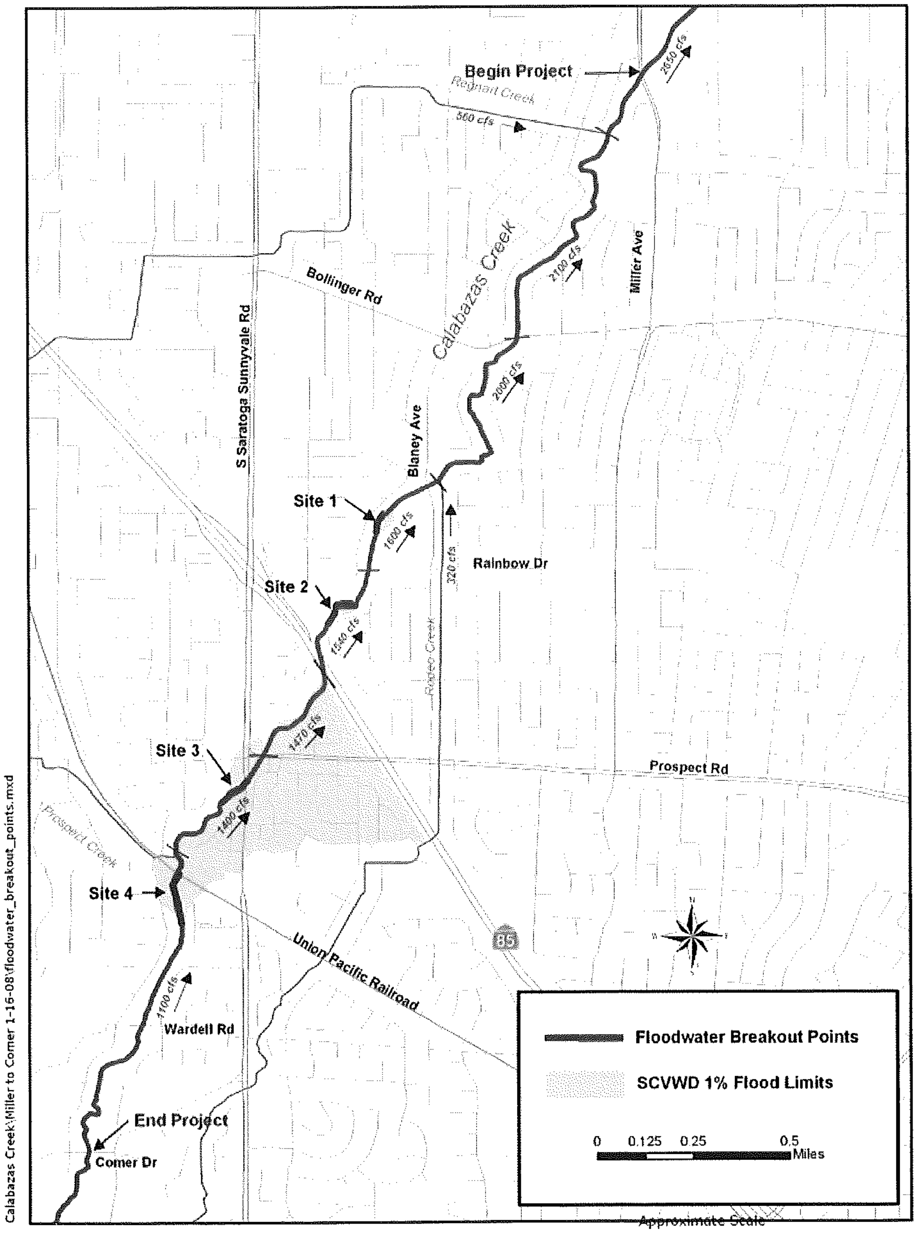


Figure 3-1: Calabazas Flood Breakout Points

3.1 FLOODING PROBLEMS

Calabazas Creek

Longtime creek-side residents will remember that historically significant flooding occurred at Bollinger Road and Miller Avenue. Figure 3-1 does not include these 2 sites because the Miller Avenue culvert was rebuilt in 1998, and the Bollinger Road Bridge was rebuilt in 2007 and 2008. At the present time, both locations have sufficient capacity to contain the 1% flood.

The 4 sites identified in Figure 3-1 as flood breakout points on Calabazas Creek include:

Site #1 - Calabazas Park (between Rainbow Drive and Blaney Avenue) of San Jose
Site #2 - At the pedestrian bridge in Cupertino Creekside Condominium apartments in San Jose
Site #3 - At Coldwell Banker Real Estate parking lot upstream of Saratoga-Sunnyvale Road in Saratoga
Site #4 - Upstream of the Union Pacific Railroad (UPRR) crossing in Saratoga.

Site #1 is located in Calabazas Park between Blaney Avenue and Rainbow Drive. There was a 200-ft long section in the east (park-side) bank where 1% flood would overtop the bank by approximately 0.5 ft. It so happened that the City of San Jose constructed a BMX Park adjacent to Calabazas Creek at Site #1 in 2007. Grading required to build the BMX Park raised the adjacent Calabazas Creek bank to eliminate flooding at this location. Hence, this site is no longer a flooding concern and the Problem Definition / Refined Objective Report was updated accordingly.

Site #2 is located in the Cupertino Creekside Condominium (CCC) apartments where a pedestrian bridge crossing over the Creek is constricting floodwater and causing overtopping. The overflowed floodwater will inundate an existing CCC swimming pool, but is otherwise contained by the higher ground of the Calabazas Creek Circle on the east overbank. The pedestrian bridge was installed over Calabazas Creek without a District permit in 1964. To prevent flooding from this site will require removal or replacement of the pedestrian bridge by CCC. At this time, because the floodwater is still contained in the creek valley, and only affects the CCC swimming pool, there is no immediate plan for this project to address flooding at Site #2.

Site #3 is located at where Calabazas Creek enters a long culvert under Saratoga-Sunnyvale Road, the San Jose National Bank and Prospect Road. See Figure 3-2 for location. Flooding at this site is caused by an inadequately sized culvert opening near the entrance, at the west face of Saratoga-Sunnyvale Road. The culvert was originally constructed by the County in 1926. It went through several modifications with road upgrades over the years, and presently has varied cross-sectional dimensions and through its length. The constriction at the culvert entrance is backing water up and causing overflow onto the parking lot of the Coldwell Banker Real Estate Office to the northwest. The floodwater then travels across the Saratoga-Sunnyvale Road to the east and across Prospect Road to the north. The estimated inundation area is shown in Figure 3-1.

Site #4 is located at where Calabazas Creek goes under the Union Pacific Rail Road Bridge in Saratoga, south of the Prospect Road. Flooding is caused by an inadequately sized railroad bridge owned by the Union Pacific Railroad. The existing 6-ft-high-by-13-ft-wide opening is not large enough to pass the 1% flood, and will force the water level to rise in the upstream. Floodwater will break out on both sides of the creek as shown in "Figure 3-3. It then flows in a general northeasterly direction toward Saratoga-Sunnyvale Road, as shown in Figure 3-1.

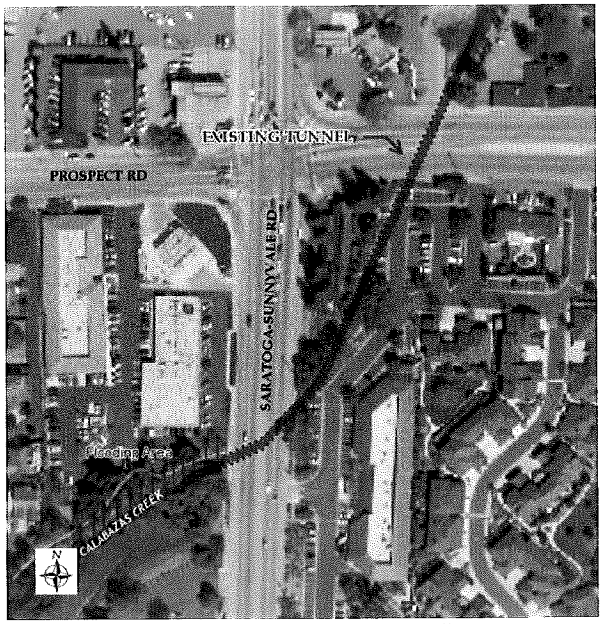


Figure 3-2: Site 3 Flooding

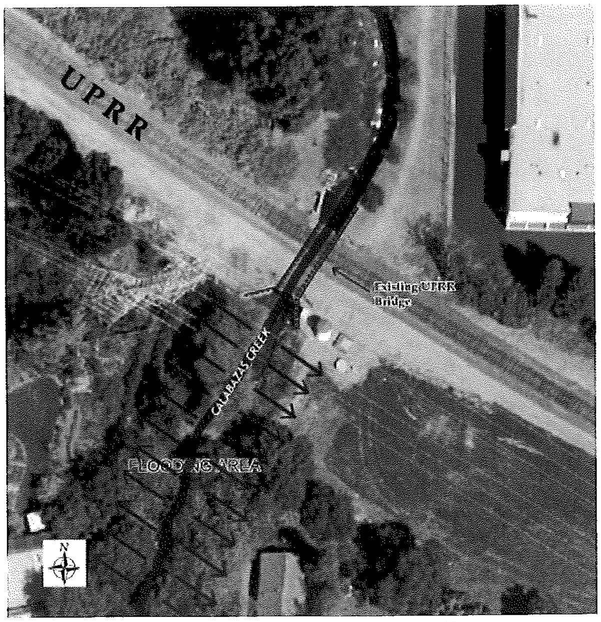


Figure 3-3: Site 4 Flooding

Regnart Creek

Regnart Creek has sufficient capacity to contain the 1% flood flow. The worst condition is at East Estate Drive, just upstream from the confluence with Calabazas Creek, where the culvert will be nearly full with less than 1 ft of freeboard, or safety margin, to the top of bank. This is consistent with observation reports by the community.

Rodeo Creek

Hydraulic analysis showed Rodeo Creek to have sufficient capacity to contain the 1% flood. However, the community has observed near-flooding condition in Rodeo Creek in recent years. This may be caused by the Calabazas overbank flows leaving Calabazas Creek at UPRR and Saratoga-Sunnyvale Road, entering into the storm drain system which drains into Rodeo Creek, and adding to the runoff from Rodeo watershed itself. This may have happened in the February 1998 flood. After this project addresses flooding at Sites #3 and #4 of the Calabazas Creek, Rodeo Creek will see the flows consistent with our hydraulic models.

Prospect Creek

There is no reported flooding on Prospect Creek. This tributary flows through less densely populated, hilly areas of Saratoga and is not known to have flooding problems.

FEMA Flood Map

The FEMA flood map (see Figure 3-4) is consistent with results of analysis performed in this project. Because FEMA only presents areas inundated with 1-foot or more of water, but the District shows all areas in the path of floodwater, the FEMA floodplain boundary is less extensive than what is shown in Figure 3-1 "Calabazas Flood Breakout Points".

The new cost estimate for potential damages from a 1-percent flood event is $11 million. This estimate is based on approximately $26,250 of damages incurred per dwelling. See the "Calabazas 1-Percent Flood Limits" in Section 2.6 of this Report for the explanation of why these potential damage costs are different from those listed in the Clean Safe Creeks & Natural Flood Protection publication (July 25, 2000).

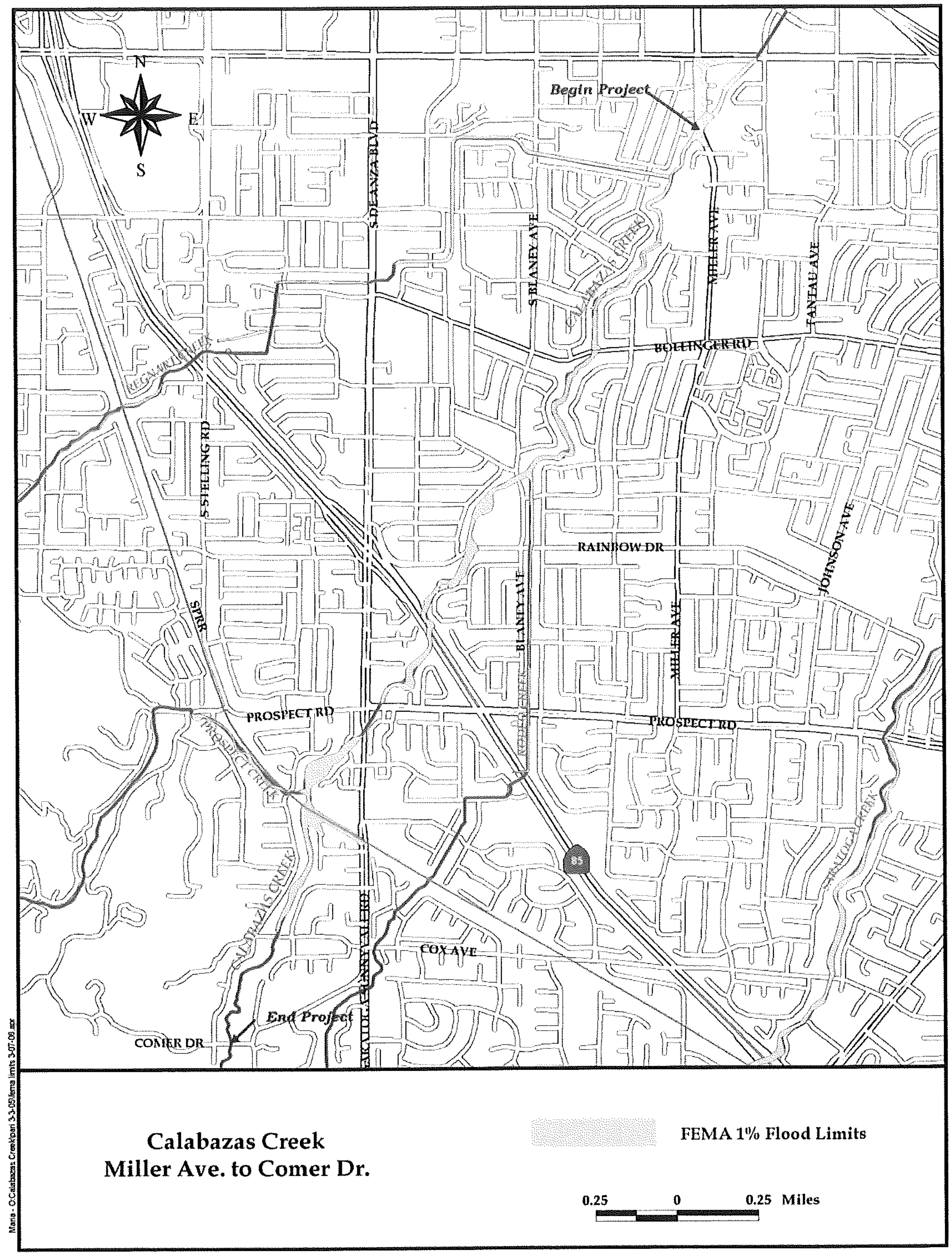


Figure 3-4: FEMA Flood Map

3.2 EROSION PROBLEMS

The Calabazas Creek in the project reach has experienced different levels of geomorphic changes in the past. But, in general, a combination of land subsidence, channel degradation and bank erosion produced the steep, incised channel cross-section of today. This is especially manifested in the reach downstream of Bollinger Road, where steep banks are typically 20 ft or higher.

Some anthropogenic effects include the construction of the Comer debris basin in 1973, which deprived the downstream channels of sediment supply for a few years, and caused the channel bed to degrade to a maximum of 6-7 ft at the downstream face of Comer Dam. Urbanization of the Cupertino-Saratoga area in the 60's and 70's pushed most residential backyards to within a few feet of the top of bank of the creeks. The increased storm runoff in turn caused more erosion in the channel.

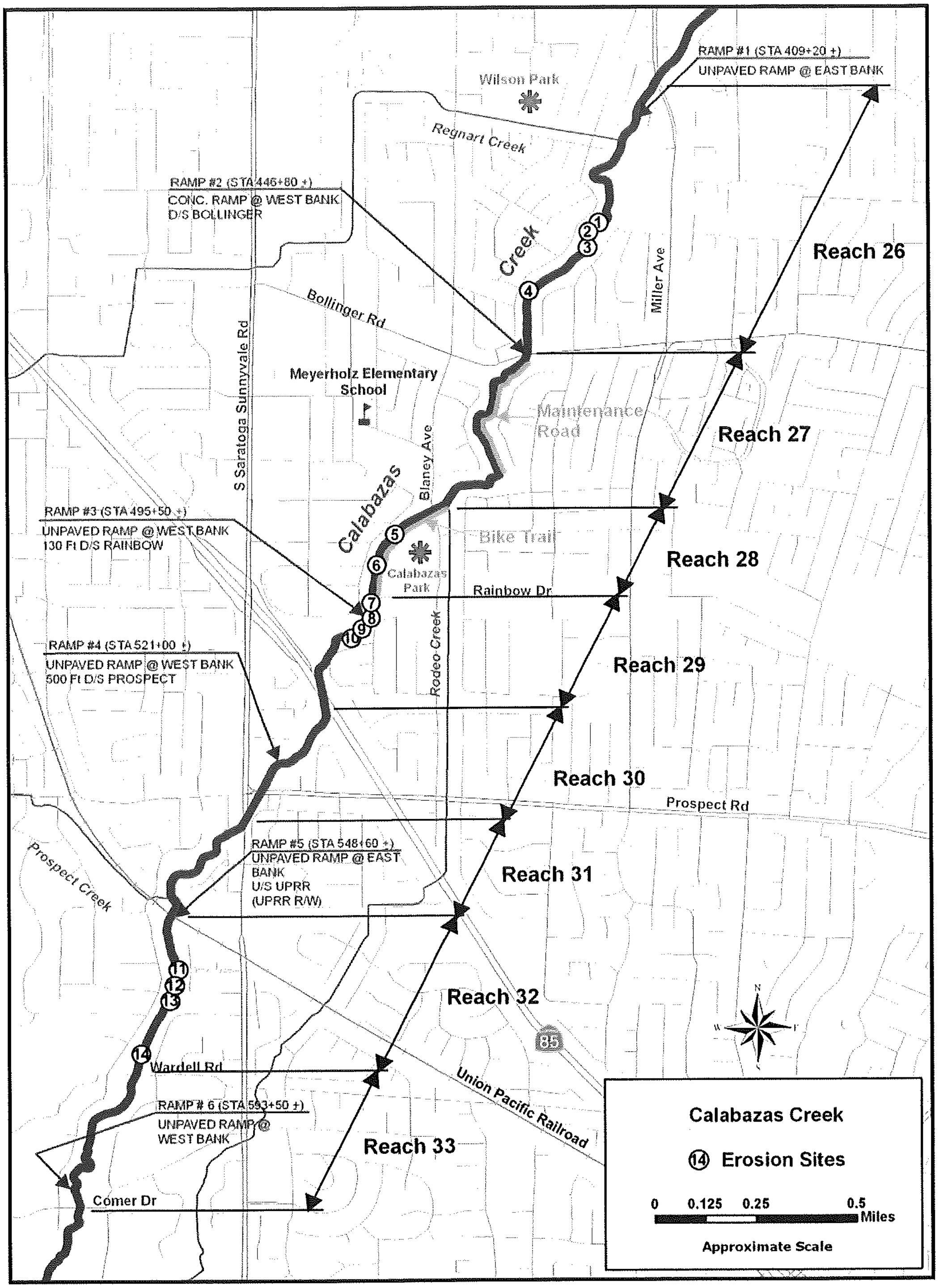
Today, the Calabazas Creek is longitudinally stable, meaning that the channel bottom is not degraded noticeably any more. However, bank erosion is still causing soil loss and threatening slope failure in many channel sections of the project reach. The project team has identified 14 locations where bank erosion is significant and is prepared to protect these sites from further damage. These sites are shown in Figure 3-5, Erosion Repair Sites.

One of the major criteria for selecting erosion repair sites is to do no harm. In other words, the repair must not cause harm in the following 3 ways:

1) Adversely affect flow conditions
2) Cause significant environmental impacts
3) Relocate the problem to neighboring reaches.

The Staff Recommended Alternative Report (SRAR) cited 25 erosion sites, but this was reduced to 14 sites in this Report. Eleven of the sites identified in the SRAR were eliminated because their repair would have caused harm in at least 2 of the 3 ways listed above.

There are chunks of concrete debris that, instead of protecting the channel surface, are redirecting flows and causing erosion to downstream sites. There are also volunteer trees in the channel bottom that are causing significant erosion to neighboring channel banks. These problems will be identified in the description below in Table 3-1.



Calabazas Creek\Miller to Comer 1-16-08\erosion_sites&maintenance_access_with_reaches.mxd

Figure 3-5: Erosion Repair Sites

RCH	#	STA	Erosion Site Description
26	1	424+33	20' high bank, 22' long erosion on east bank. Possible isolated areas of slope failure. Upper bank is nearly vertical, consider planting groundcover. Lower bank may be protected on 1:1 slope using log mattress. Downstream edge borders 3 cottonwood trees at toe line. These trees are to remain. Vegetation Management trims these trees regularly.
	2	425+06	20' high bank, lower 8' needs protection. 19' long erosion on east bank. Bare soil on upper slope that needs groundcover planted for protection.
	3	428+81	Toe erosion, 12.5' long and 5' high. Need ground cover planted on upper slope.
	4	439+00	Covered in blue tarp. Slope under 12" storm drain is eroded. Fill pocket 9' high, 9' deep and 2' long. Leave other part under tarp intact.
28	5	484+67	East bank is eroded to expose roots of 4 oak trees on top of bank. 36' long steep bank (1/2:1) needs log mattress protection. Also 5' wide bank needs soil and rock fill. Upstream from this site, west bank is protected by geocells. Several dead and live willows near bottom of geocells cause significant downstream erosion problem and should be removed.
	6	489+11	Flow shedding off loose rocks upstream to cause erosion of this site to expose roots of an oak tree. 30' long erosion, 6' high, needs soil and rock protection to 1:1 slope.
29	7	494+62	Just upstream of concrete sacks on east bank. Eroded 3'x4'x3' hole near toe and 10' long section 5' high needs rock protection.
	8	497+18	At Cupertino Creekside Condominium. Erosion around outside bend. Need to remove dead tree trunks. 15' long and 8' high section needs soil and rock fill to connect to existing concrete sacks. Need angular rocks to stay on 1:1 slope. Bend radius 32 ft and channel width 16 ft.
	9	497+85	Just upstream from CCC site. A bent willow tree in channel will affect flow capacity and should be removed. 37' long and 6' high area, with downstream end around an oak tree, needs soil and angular rock fill. Final slope 1:1.
	10	498+27	Around outside bend, 56' long 5' deep and 6' high pocket, needs soil and rock fill. Toe line is staked in field. Bend radius 36' and channel width 17'.
32	11	556+70	Eddy erosion off edge of concrete sacks. 10' long 7' high section needs rock cover. Up to bottom of oak tree.
	12	558+50	Erosion of west bank caused by flow shedding off volunteer willow tree in channel bottom. Need to remove willow tree and line channel bank with rocks up to the 4" plastic drain pipe.
	13	558+93	West bank eroded up to the top of bank, 9 ft high. Remove existing concrete pieces on slope. Fill isolated holes with soil. Cover with rocks and plant cottonwood cuttings 3' from bottom. Final slope 1:1.
	14	567+93	Failed concrete sack structure around a 30" storm drain pipe. Need to remove existing concrete and concrete sacks and line 8' long, 6' high section with rocks.

Table 3-1: Erosion Repair Sites

Minor erosion occurs on Rodeo and Regnart Creeks. The banks are not very steep on either of these two tributaries, and the erosion there doesn't pose a risk on adjacent properties. These sites will be handled by District's Field Operation Unit through its Stream Maintenance Program (SMP) process.

A complete sediment transport study (SCVWD, 2006) was performed to evaluate possible channel bed erosion. The report concluded that the Calabazas Creek bed is stable within the project limits.

3.3 OPERATIONAL PROBLEMS

There are six existing maintenance ramps to access Calabazas Creek in the project reach. These access points are discussed in Chapter 6. They are sufficient for routine maintenance or project construction purposes. Regularly the Watershed Field Operations Unit and Vegetation Management Unit inspect sites along Calabazas Creek to identify work needed to meet watershed goals.

As far as watershed operation is concerned, there is no problem or additional need for this project to provide right of way or physical access.

CHAPTER 4 – INTEGRATED WATER RESOURCE MANAGEMENT PROGRAMS

4.1 SANTA CLARA VALLEY WATER DISTRICT

The District manages wholesale drinking water resources and provides stewardship for the county's watersheds, including 10 reservoirs, hundreds of miles of streams and groundwater basins. The Stevens Creek pipeline turnout, found within the project limits, which provides recharge of the ground water is an example of this stewardship. The temporary disruption of this recharge work will be held to a minimum necessary for the proposed construction work at the Union Pacific Railroad, Saratoga-Sunnyvale Road, and the channel erosion repair sites.

The District is also responsible for providing flood protection throughout Santa Clara County. The two flood protection measures provided by this project at the Union Pacific Railroad and Saratoga-Sunnyvale Road are examples of District flood protection work.

Clean Safe Creeks Program

In November of 2000 the voters of Santa Clara County supported a ballot measure entitled the Clean, Safe Creeks and Natural Flood Protection Plan.

The flood protection, erosion control and channel enhancements between Miller Avenue and Comer Drive are supported by this program.

Adopt-A-Creek Program

Local community groups have volunteered to participate in the District's Adopt-A-Creek program. As of March, 2008, three organizations were participating in the program for Calabazas Creek within the project limits as shown in Table 4-1, "Adopt-A-Creek" volunteers below:

ADOPT-A-CREEK VOLUNTEER	AREA ADOPTED	
	FROM	TO
Lynbrook High School	Bollinger Rd	Blaney Ave
	Miller Ave area	
Saint Joseph of Cupertino School	Miller Ave	Bollinger Rd
Cub Scout Pack 411	Blaney Ave	Rainbow Dr

Table 4-1: Adopt-A-Creek volunteers

Volunteers in this program provide community service within the creek such as trash removal. Participants sign up for 2 year periods. Advertisement of the program and participation in the program is done through the District's website.

Water Supply Program

Most of the project reach is used for groundwater recharge by the District. Imported water from the Stevens Creek pipeline is released about one quarter mile upstream of Prospect Road near the Union Pacific Railroad. The recharge zone usually extends downstream past Interstate 280 to about N. Tantau Avenue. Depending on the gravels in the creek, the released water may go sub-surface in some areas and re-surface farther downstream.

CHAPTER 5 – PROJECT DEVELOPMENT

This chapter describes the process of formulating alternatives considered for the Calabazas Creek Flood Protection Project and the methodology followed to develop the recommended project. Additionally, the development of the recommended erosion control sites and the two channel enhancements recommended for Board consideration is outlined.

5.1 STUDY AREA and APPROACH

The Study Area, as shown in Figure 2-2, "Study Area", covers the entire Calabazas Creek Watershed upstream of Miller Avenue. It includes the main stem of Calabazas Creek and two tributaries, Regnart Creek and Rodeo Creek. A smaller tributary, Prospect Creek, is not included in the study because it runs through more rural, less densely populated areas and is not known to have flooding problems.

Hydraulic and sediment transport analyses were first performed to determine channel capacity and establish morphologic stability. The results identified locations of flooding concerns and also showed that the existing Calabazas Creek was in a dynamic equilibrium state. The Creek did not show evidence of systematic aggradation or degradation that require regular maintenance. This finding was important in the sense that all channel modification work could then be designed to maintain the existing hydraulic condition, i.e., the same velocity, shear stress, energy slope and sediment load. The need to provide cutoff walls in anticipation of future degradation is also minimized.

Site inspection was conducted to identify locations of significant bank erosion and opportunities for watershed enhancement. Those sites that had experienced significant erosion and were amenable to repair which would not adversely affect the creek, were selected for bank protection. Some sites having steep bank slopes, no space on top of bank to taper back the slope, and no sufficient flow area in the channel to tolerate encroachment, had to be left alone. One important criterion in selecting erosion sites was to do no harm. If a repair might encroach into the flow area, accelerate flow velocity, and cause damage to downstream reaches, it would not be selected. The repair methods also were limited to using natural materials such as logs and rocks. Incorporating planting to allow tree roots to develop long-term erosion resistance was the strategy involved in using logs that would deteriorate in 15-20 years.

The enhancement opportunities that would improve natural flood protection, water quality, recreational use, or ecological functions were identified for Board approval. Two opportunities were found. One involves revegetation to improve riparian habitat, and the other, removal of Comer Dam that would improve flood protection, fish habitat and recreational values of the creek.

The alternatives the project developed to provide flood protection, bank stability and watershed enhancement are described in the following.

5.2 CONCEPTUAL ALTERNATIVE EVALUATION

Evaluation of alternatives was conducted in 2 stages. The 1st stage was to develop and screen conceptual alternatives to arrive at a number of feasible alternatives. The 2nd stage was to evaluate the feasible alternatives to identify the optimized, staff-recommended alternative.

Screening of the conceptual alternatives focused on the project objectives, costs, technical feasibility, and right-of-way availability. The Conceptual Alternative Criterion (CAC's) are described below.

CAC1 - Project Objectives: Conceptual alternatives must satisfy the project objectives predetermined in the Project Plan to be carried forward to the feasible analysis stage.

CAC2 - Project Cost: The project's budget for design and construction was a not-to-exceed $35 million (in year 2000 dollars). If the cost of an alternative exceeded this amount significantly, it would not be feasible.

CAC3 - Technical Feasibility: This criterion indicates if a project can be actually built using widely available construction materials and methods. Alternatives that have been determined to be technically feasible could be allowed to continue to the feasible alternatives phase.

CAC4 - Right-of-Way Availability: This criterion refers to whether or not the required right-of-way is likely to be available for the project. Conceptual alternatives that would likely have necessary rights-of-way could be carried forward into feasible alternative analysis.

Conceptual Alternative screening results are summarized in Table 5-1 "Conceptual Alternative Evaluation". See Figure 3-1, "Calabazas Flood Breakout Points" for a map of the flood sites and Appendix I for a complete description of the flood protection alternatives.

SITE	ALTERNATIVE		"CAC" EVALUATION	FEASIBLE?
All	No Project		Does not meet CAC1	No
	Floodproofing		Does not meet CAC2.	No
Site 1	Alt 1A	Floodwall @ Calabazas Park	Site 1 eliminated from further study because Alt 1C was implemented by the City of San Jose in December, 2006.	No
	Alt 1B	Channel Widening @ Calabazas Park		No
	Alt 1C	BMX Park Grade elevation @ Calabbazas Park		No
Site 2	Alt 2A	Raising Existing Footbridge & Floodwall	Does not meet CAC2. Flooding was limited mostly to open land with no structures. Very low benefit cost ratio.	No
	Alt 2B	Footbridge Relocation & Floodwall		No
Site 3	Alt 3A	RCB Bypass	Meets all CAC for proceeding to Feasible Evaluation	Yes
	Alt 3B	Double RCB	Meets all CAC for proceeding to Feasible Evaluation	Yes
	Alt 3C	Floodwall	Meets all CAC for proceeding to Feasible Evaluation	Yes
	Alt 3D	Swale Detention with Floodwalls	Meets all CAC for proceeding to Feasible Evaluation	Yes
	Alt 3E	Swale and Culvert modification	Meets all CAC for proceeding to Feasible Evaluation	Yes
Site 4	Alt 4A	RCP Bypass	Meets all CAC for proceeding to Feasible Evaluation	Yes
	Alt 4B	Bridge Replacement	Meets all CAC for proceeding to Feasible Evaluation	Yes
	Alt 4C	Floodwall	Meets all CAC for proceeding to Feasible Evaluation	Yes

Table 5-1: Conceptual Alternative Evaluation

5.3 FORMULATION OF FEASIBLE ALTERNATIVES

Flood Protection

As described in Chapter 3, two flooding sites were carried forward to the Feasible Alternatives stage on the main stem of Calabazas Creek to have flood concerns during a 1% flood. These two sites are the Coldwell Banker parking lot upstream from Saratoga-Sunnyvale Road, and upstream of the Union Pacific Railroad (UPRR) crossing. The paragraphs below describe the reasoning by which the flood protection alternatives at these two sites were developed.

Sunnyvale-Saratoga Road Culvert (Site #3)

An earthen swale exists upstream of the Sunnyvale-Saratoga Road culvert. It serves as a natural bypass for the upstream channel. Hence, it is logical to consider developing the natural swale into a detention pond to store flood water and reduce the peak flood flow.

The existing Sunnyvale-Saratoga Road culvert was built and rebuilt over many years in the past. The size of the culvert entrance is too small to pass flood flows of today. Hence, several options considered were to enlarge the existing culvert or build a new culvert to carry part of the flow, construct a bypass along existing culvert with different alignment from Prospect Road to Saratoga-Sunnyvale Road under the San Jose National Bank (SJNB) parking lot

It is also possible to build flood walls along the channel and at the culvert entrance to contain floodwater in the channel.

These alternatives and combinations of them were considered in developing a solution to provide flood protection at the Sunnyvale-Saratoga Road site.

UPRR Bridge (Site #4)

At the UPRR site, the cause of flooding was simply the undersized bridge being too small to pass the flood water. Alternatives included enlarging the existing bridge, building a new culvert in parallel, construction of an underground Reinforced Concrete pipe (RCP) bypass from downstream of UPRR to 120 feet upstream of the UPRR under residential backyards and railroad tracks on the northwest side of the creek and building floodwalls along the upstream channel to contain the water.

Erosion Protection

Erosion protection solutions such as "acquiring real estate to set back top of bank and flatten bank slopes" or "constructing concrete channels" were not considered in light of their impracticality in terms of community impacts, costs and environmental effects.

As described in Chapter 3, the erosion protection sites were selected based on the severity of erosion and amenability to repair. The protection methods considered followed the principles of the Hydraulic Design Manual (SCVWD, 2007), mainly to use bioengineering methods and avoid adversely affecting the existing hydraulic and environmental conditions. Fourteen (14) sites were thus selected. They used either rock riprap or log mattress for bank protection, incorporating planting of native trees for long term erosion resistance. The proposed work also included removal of concrete debris and volunteer trees in the channel that were the culprit of some erosion problems. Details of the erosion work are described in Section 6.2 of this Report.

Watershed Enhancement

The two enhancement opportunities identified were removal of Comer Dam and revegetation of a District-owned site north of Prospect Road.

Removing the Comer Dam would restore the creek to a natural-looking profile. Three alternatives were examined for this enhancement opportunity. They included (1) a complete removal of the dam and replacement with a uniform slope over 2700 ft of the creek distance, (2) complete removal and replacement with 10 small drop structures over 750 ft of creek distance, and (3) a partial removal with replacement of a uniform slope over 500 ft of creek distance. The analyses of these three alternatives are provided in Appendix J of this Report.

The revegetation enhancement was proposed to replace existing shrubs in a 3800 square feet riparian area with native trees. The District owns a 1 acre site about 500 ft north of the Prospect Road. The 3800-square-feet area along the Creek would be planted with willows near the toe and cottonwoods, oaks and elderberries in the upper bank. This enhancement opportunity was identified, but not analyzed for alternative evaluation because of its nature.

5.4 FEASIBLE ALTERNATIVE EVALUATION

Alternatives at each of the flood sites were first evaluated, and then compared using the District's Natural Flood Protection (NFP) procedure (SCVWD, 2000). The NFP procedure entails the evaluation of each alternative using the nine different objectives listed below, which constitute multidisciplinary considerations including engineering and environmental planning.

1. Provide additional protection from flood damage beyond project objectives
2. Support ecological functions and processes*
3. Integrate physical stream functions and processes
4. Minimize maintenance requirements
5. Integrate within the context of the watershed
6. Protect the quality and availability of water
7. Cooperate with other agencies to achieve mutually beneficial goals
8. Maximize community benefits beyond flood protection
9. Minimize life cycle costs

Each of the objectives and their ranking is shown in Table 5-2, "Site #3 NFP Rankings" for Saratoga-Sunnyvale Road and Table 5-3, "Site #4 NFP Rankings" for the UPRR.

	***RCB Bypass**	**Double RCB**	**Floodwall**	**Swale Detention with Floodwalls**	**Swale and Culvert replacement**
District Ends Policy 2.2.1 (Natural Flood Protection):	**Alt 3A**	**Alt 3B**	**Alt 3C**	**Alt 3D**	**Alt 3E**
1. Provide protection from flood damage	3	3	3	3	3
2. Support ecological functions and processes	2	2	1	2	2
3. Integrate physical stream functions and processes	1	1	1	3	2
4. Minimize maintenance requirements	3	3	1	2	3
5. Integrate within the context of the watershed	2	2	2	3	4
6. Protect the quality and availability of water	3	3	2	3	3
7. Cooperate with other local agencies to achieve mutual goals	2	2	2	2	2
8. Maximize community benefits beyond flood protection	2	2	1	2	2
9. Minimize life-cycle costs	3	3	3	3	3
Total NFP Points	21	21	16	23	24

*RCB = Reinforced concrete box

Ratings Key: 5=Outstanding; 4=Very Good; 3=Adequate; 2=Fair; 1=Poor

Table 5-2: Site #3 NFP Rankings

	*RCP bypass	Bridge Replacement	Floodwall
District Ends Policy 2.2.1 (Natural Flood Protection):	**Alt 4A**	**Alt 4B**	**Alt 4C**
1. Provide protection from flood damage	3	3	3
2. Support ecological functions and processes	1	2	1
3. Integrate physical stream functions and processes	1	1	1
4. Minimize maintenance requirements	2	2	2
5. Integrate within the context of the watershed	1	3	2
6. Protect the quality and availability of water	3	3	2
7. Cooperate with other local agencies to achieve mutual goals	2	2	2
8. Maximize community benefits beyond flood protection	2	2	2
9. Minimize life-cycle costs	3	3	3
Total NFP Points	18	21	18

*RCP = Reinforced concrete pipe

Ratings Key: 5=Outstanding; 4=Very Good; 3=Adequate; 2=Fair; 1=Poor

Table 5-3: Site #4 NFP Rankings

The NFP objectives include flood protection, support of ecological functions, integration of physical stream processes, minimization of maintenance requirements, maximization of watershed values, protection of water quality, cooperation between public agencies, maximization of community benefits, and minimization of life-cycle costs. These objectives address both short-term and long-term effects of the project in multi-faceted considerations.

The alternatives developed for the 2 flooding sites were evaluated using this set of criteria. A detailed description of this analysis is provided in the Staff Recommended Alternative Report for this project. Table 5-4, "Flood Alternative Rankings" lists the alternatives and their rankings as a result of the NFP evaluation.

5.5 COMMUNITY INVOLVEMENT

During the course of the study, District staff has met with various homeowners, residents, businesses, and public agencies. Three groups of public meetings were held to convey the results of District work and collect public opinions on the project.

The first set of public meetings covered the existing conditions of the creek. District staff described the flooding problems, maintenance problems and channel enhancements opportunities identified at that time. Over 90 residents attended these meetings. The dates and locations are summarized below.

Existing Conditions Meetings:

July 25, 2005	Cupertino Community Center
August 2, 2005	Saratoga Senior Center
August 25, 2005	Cupertino Community Center

The second set of public meetings covered the conceptual alternatives developed for the creek. Over 70 residents attended these meetings. The dates and locations are summarized below.

Conceptual Alternatives Meetings:

January 31, 2006	Cupertino Community Center
February 2, 2006	Saratoga Senior Center

Feasible Staff Recommended Alternatives Meetings:

June 12, 2008	Saratoga Senior Center
June 19, 2008	Cupertino Community Center

In all three meetings, residents expressed more interest in the District's erosion control work than flood protection or channel enhancement work.

In addition to the public meetings, District staff has coordinated with the Cities. District staff met with City of San Jose staff on January 27, 2006 to provide input on the City's BMX Park proposals. District staff also met with the City of Saratoga on October 17, 2007 and the City of Cupertino on October 24 2007 to present the recommended project and obtain City input.

5.6 PROJECT SELECTION

For each of the 2 flood prone sites, the feasible alternative evaluation process produced a ranking for all alternatives studied. The highest ranking flood protection alternatives were:

- Alt 3E: Swale in combination with culvert modification at Saratoga-Sunnyvale Road
- Alt 4B: Clear Span Bridge Replacement at the UPRR

SITE	RANK	ALTERNATIVE		NFP RANK PTS	COST (mult by 1,000)
Site 3	1	Alt 3E	Swale and Culvert replacement	24	$2,510
	2	Alt 3D	Swale Detention with Floodwalls	23	$1,174
	3	Alt 3B	Double RCB	21	$4,922
	4	Alt 3A	RCB Bypass	21	$5,502
	5	Alt 3C	Floodwall	16	$451
Site 4	1	Alt 4B	Bridge Replacement	21	$2,217
	2	Alt 4C	Floodwall	18	$1,132
	3	Alt 4A	RCP bypass	18	$2,410

Table 5-4: Feasible Alternative Rankings

Alternatives "Alt 3E, Swale and Culvert modification" and "Alt 4B, Bridge Replacement" were the highest ranking feasible alternatives for Site #3 and #4 respectively. These two alternatives comprise the flood protection elements of the recommended project.

For the Saratoga-Sunnyvale Road site, the swale would be developed into a dry detention pond to store floodwater temporarily. Because the size of the swale is limited, to contain the 1% flood would require enlarging the culvert entrance as well. Hence, this proposed alternative Alt 3E would utilize the natural flood protection function of the swale, and minimize the culvert modification work to a small portion near the entrance under Saratoga-Sunnyvale Road.

For the UPRR site, the proposed alternative would replace the existing 13' by 7' culvert with a 20-foot by 7-foot clear span bridge or culvert opening. The design would minimize environmental impact by expanding only to the west side of the creek.

For erosion protection, the project would recommend using natural logs and rocks to provide bank protection to 14 sites listed in Table 3-1. These sites were selected to protect the properties on the top of bank, save heritage trees endangered to be toppled, or stabilize channel banks to minimize soil loss and improve water quality.

For channel enhancements, staff recommends two opportunities for Board consideration. They included a revegetation opportunity to plant native riparian trees on the 3800 square feet of a site owned by the District and a channel restoration opportunity to replace the Comer Dam with a series of 10 small rock steps over a 750' long reach of the creek.

A more detailed description of the staff-recommended project is provided in Chapter 6.

CHAPTER 6 – STAFF RECOMMENDED PROJECT

Chapter 3 described the flooding and erosion problems within the project limits. Chapter 5 described how solutions for these problems were formulated and developed to arrive at a recommended project. This chapter describes the recommended flood protection and erosion repair project along with right of way and construction layout details.

6.1 FLOOD PROTECTION AT SARATOGA-SUNNYVALE ROAD

Culvert Modification and Swale Work

An 80-foot-long entrance section of the existing concrete culvert will be removed and rebuilt as an enlarged reinforced concrete box (RCB) to improve flow capacity and reduce upstream water depth.

The new, enlarged RCB section will be a 10-foot high by 16-foot wide box. This new section (from Station 531+22 to Station 531+94) will be constructed along the same alignment of the existing culvert under Saratoga-Sunnyvale Road. An 8-foot long transition (from Station 531+14 to Station 531+22) will connect the enlarged RCB to the existing 9-foot by 12-foot culvert.

The new RCB section will have the same slope (around 1.14%) as the culvert downstream of STA 531+14. This uniform, steep slope ensures a high-velocity, low-depth flow in the box. The entrance of the new RCB will be rounded at the soffit.
The channel upstream of the new RCB entrance will be covered by rip-rap to protect it from erosion due to the increased velocity at the box inlet. The rip-rap cover is to extend approximately twice the box height (or about 20 feet in length).

Two overflow weirs (one from STA 543+70 to STA 544+80 and the other one from STA 546+15 to STA 546+85) will be placed on the left bank (looking upstream) of Calabazas Creek to divert flow above 1,350 cfs into the existing swale. Low-lying banks between the Calabazas channel and existing swale will be raised to an elevation of at least 308.6 feet in order to convert the swale into a detention basin of capacity one acre-ft.

A one-foot diameter outlet pipe will drain the detention basin water by discharging it into the creek. The pipe will be placed at STA 533+95 and will have a flap gate at its outlet. The invert of the pipe entrance will be placed at approximate elevation 302 feet in the detention basin.

Construction of the culvert and detention basin will benefit the business and residential areas upstream of Saratoga-Sunnyvale Road. Construction work will temporarily impact traffic and possibly cause a temporary loss of parking places for local businesses. Existing trees will be impacted and the area will experience temporary noise and dust impacts during construction.

Operation and maintenance requirements for the enlarged RCB section would be minimal. Although the new section would be designed with adequate slope to move sediment, the inlet would require regular monitoring and possible removal of debris during the flow season. Swale detention would only need regular maintenance for its inlet / outlet work. The detention basin itself may need cleanup following major storms, but no additional maintenance activities would be required within the swale area. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal will remain the same.

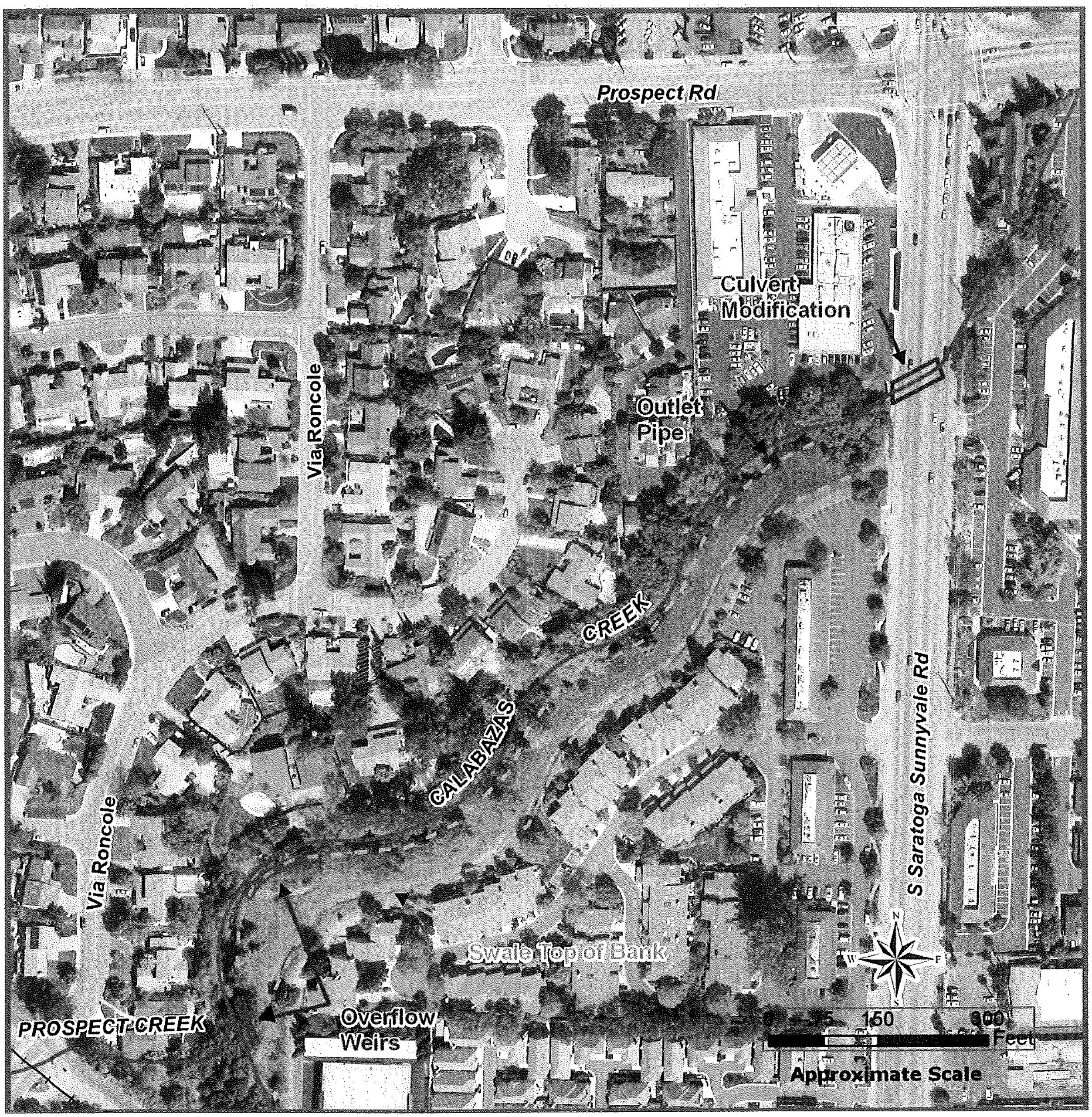


Figure 6-1: Swale Area Plan View

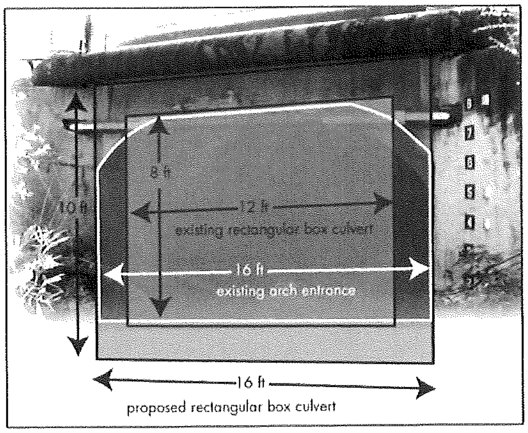

10 ft
8 ft
12 ft
existing rectangular box culvert
16 ft
existing arch entrance
16 ft
proposed rectangular box culvert

Figure 6-2: Saratoga-Sunnyvale U/S face

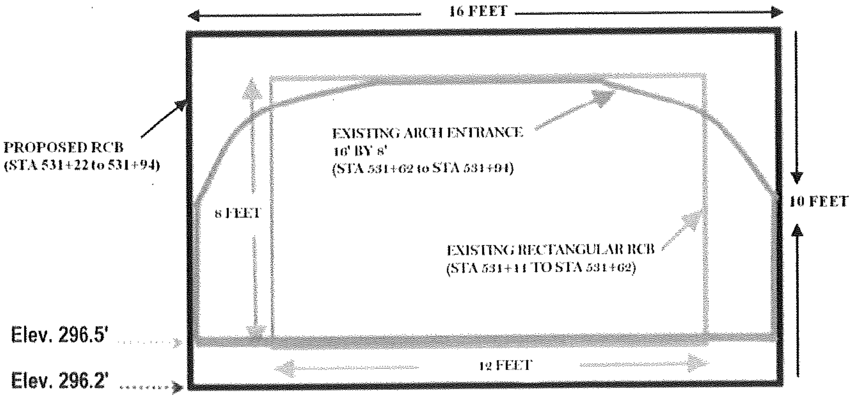


Figure 6-3: Saratoga-Sunnyvale X-section

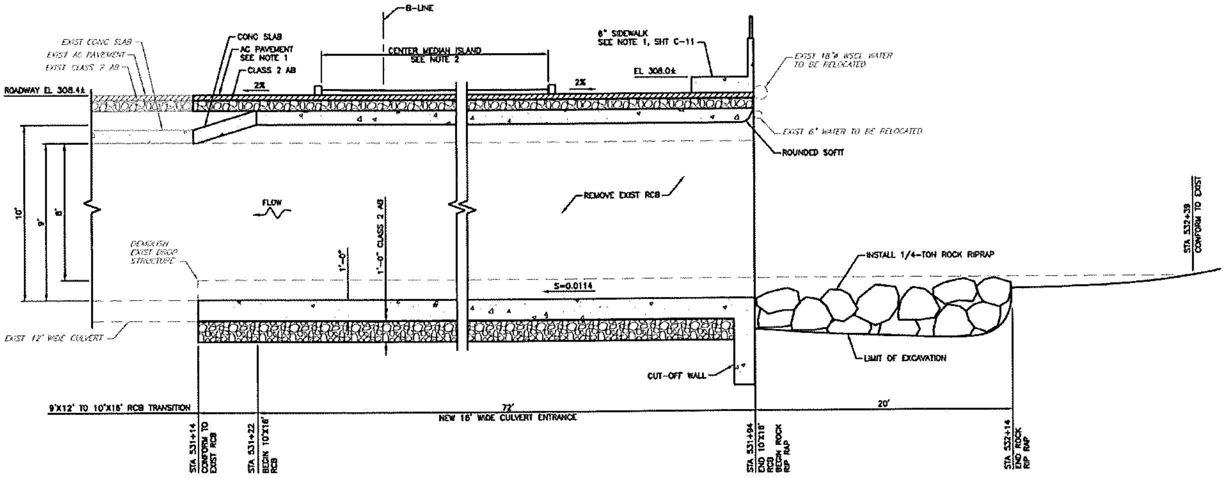

B-LINE
EXIST CONC SLAB
EXIST AC PAVEMENT
EXIST CLASS 2 AB
ROADWAY EL 308.4±
CONC SLAB
AC PAVEMENT SEE NOTE 1
CLASS 2 AB
2%
CENTER MEDIAN ISLAND SEE NOTE 2
2%
6" SIDEWALK SEE NOTE 1, SHT C-11
EL 308.0±
EXIST 18"Ø WSCL WATER TO BE RELOCATED
EXIST 6" WATER TO BE RELOCATED
ROUNDED SOFIT
10'
9'
8'
FLOW
REMOVE EXIST RCB
DEMOLISH EXIST DROP STRUCTURE
1'-0"
1'-0" CLASS 2 AB
S=0.0114
INSTALL 1/4-TON ROCK RIPRAP
STA 532+39 CONFORM TO EXIST
EXIST 12' WIDE CULVERT
LIMIT OF EXCAVATION
CUT-OFF WALL
9'X12' TO 10'X16' RCB TRANSITION
72'
NEW 16' WIDE CULVERT ENTRANCE
20'
STA 531+14 CONFORM TO EXIST RCB
STA 531+22 BEGIN 10'X16' RCB
STA 531+94 END 10'X16' RCB BEGIN ROCK RIP RAP
STA 532+14 END ROCK RIP RAP

Figure 6-4: Saratoga-Sunnyvale Profile

Rights of Way

Temporary Construction Easements (TCE's) would be needed from the City of Saratoga for most of the culvert replacement work. Additional TCE would be needed from the owners of the commercial business operations adjacent to the channel on the upstream face of Saratoga-Sunnyvale Road on the north side of the creek. Land on the north side of the creek is also being used by the Coldwell Banker Real Estate agency.

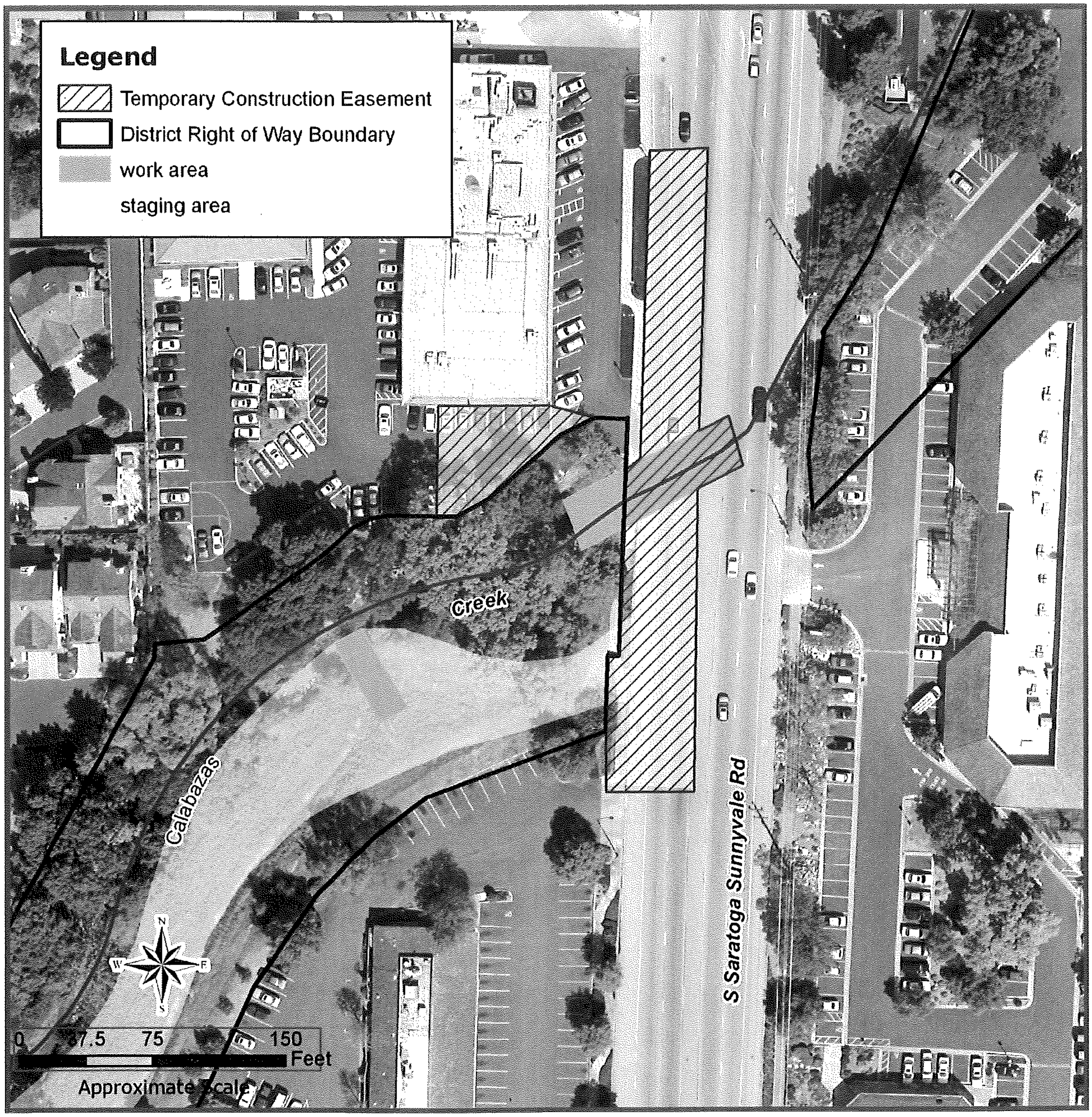


Figure 6-5: Saratoga-Sunnyvale Road ROW

The majority of work for the culvert replacement and swale work will be at the culvert as shown in Figure 6-5 “Saratoga-Sunnyvale Road ROW.

Temporary Construction Easement into the adjacent parking lot on the south side of the creek would be necessary to gain access to the swale area for the proposed weir construction. The parking lot is used by several small businesses. The business closest to the creek which would be impacted the most is Mike’s pizza parlor.

Construction Staging and Access

This work is estimated to last approximately 9 months. Of those 9 months, approximately 6months would be required within the creek watercourse and/or swale that are within California Fish & Game jurisdiction. Six traffic stages may be necessary to provide continuous operation of the existing four lanes of traffic as required by the City of Saratoga. Construction work and staging areas are shown in Figure 6-6.

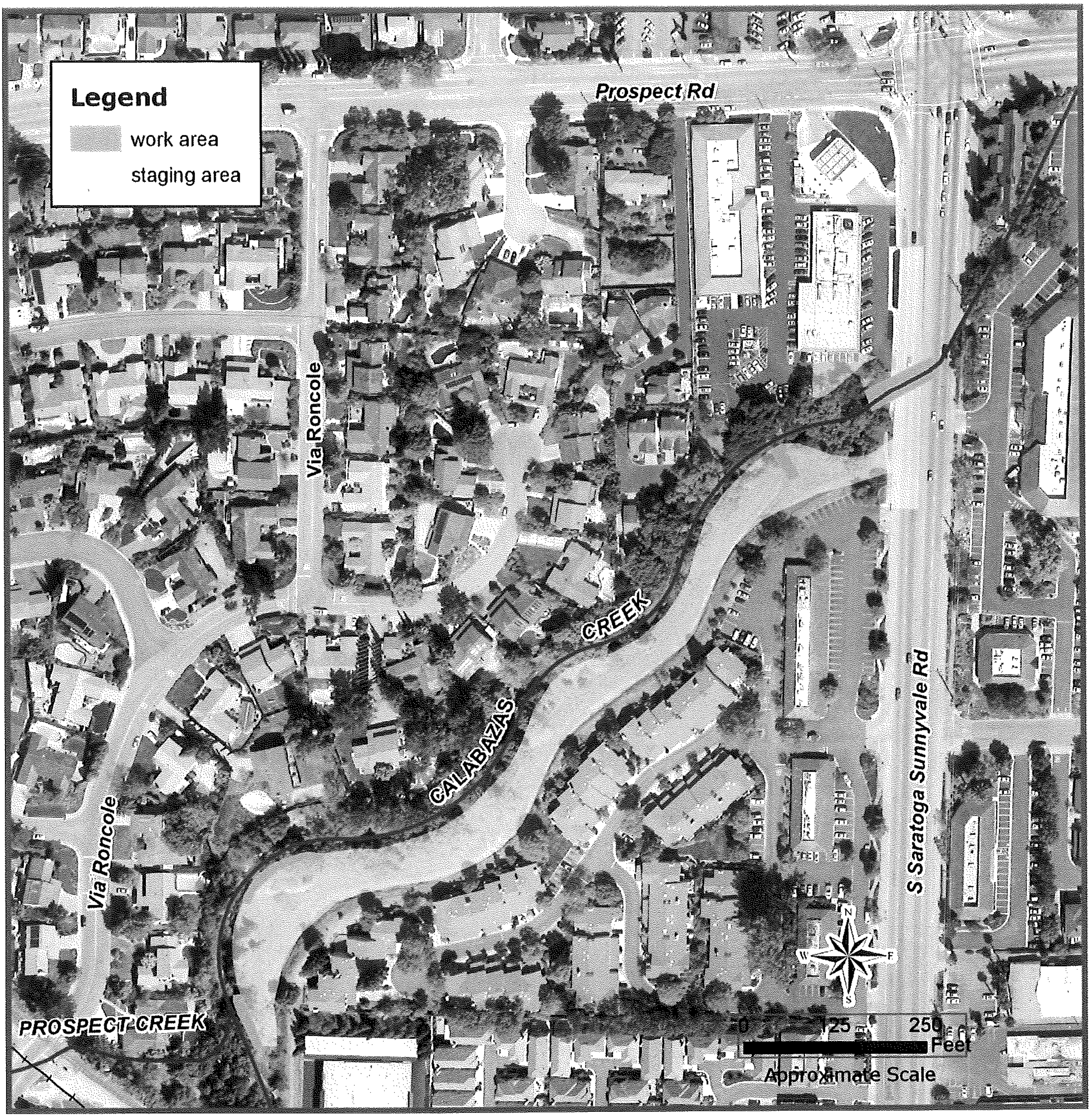


Figure 6-6: Culvert Replacement and Swale Work Staging Areas

6.2 FLOOD PROTECTION AT UNION PACIFIC RAILROAD (UPRR)

UPRR Bridge Replacement

The existing 6-foot high by 13-foot wide (average width) UPRR bridge consists of concrete abutments and an old railroad clear span bridge made out of large heavily treated wooden beams. Only the upstream face of the bridge is made of concrete, as shown in Figure 6-8. The existing structure is estimated to have been constructed in 1907. The 35-foot long channel opening under the existing UPRR Bridge varies in width from 14.5 feet on the upstream face to 11.5 feet at the downstream face. The proposed work would consist of replacing the existing wooden bridge with a clear span bridge featuring an 8-foot by 20-foot opening between approximately STA 548+28 and STA 548+63.

The larger channel opening would be achieved by lengthening the bridge to the northwest in order to avoid impacts to existing District facilities such as the Stevens Creek pipeline turnout with its associated underground vaults and gages. The new southeast abutment would be in approximately the same location as the old one, but the adjacent abutment would be approximately 12 to the northwest of the existing one.

The wider UPRR Bridge will impact local vegetation. A large stand of small diameter oak trees would be removed on the upstream side to accommodate the new upstream wingwall. A large stand of small diameter willow trees would be removed on the downstream side to accommodate the new downstream wingwall.

The construction work would be done within District and UPRR easements or fee title property. The existing bridge would be demolished and reconstructed by installing pre-cast bridge abutments and a pre-cast concrete deck in a two day construction window. Construction is expected to last six months. Contractors will be required by the construction specifications to follow applicable federal, state, and local guidelines, laws, and regulations to minimize soil erosion, water, air, and noise pollution during construction. Traffic control will be coordinated with the Cities of Saratoga.

Operation and maintenance activities for the new RCB would be similar to the existing bridge.

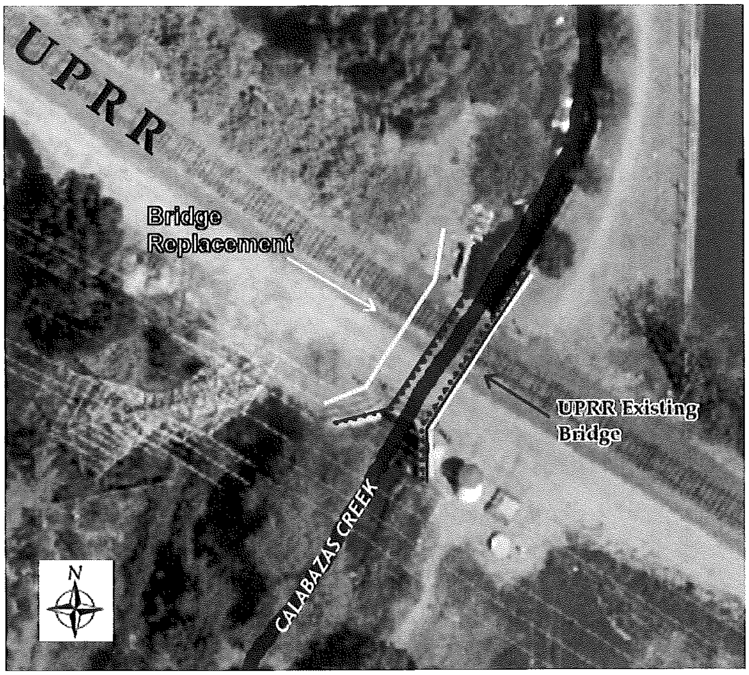


Figure 6-7: UPRR aerial

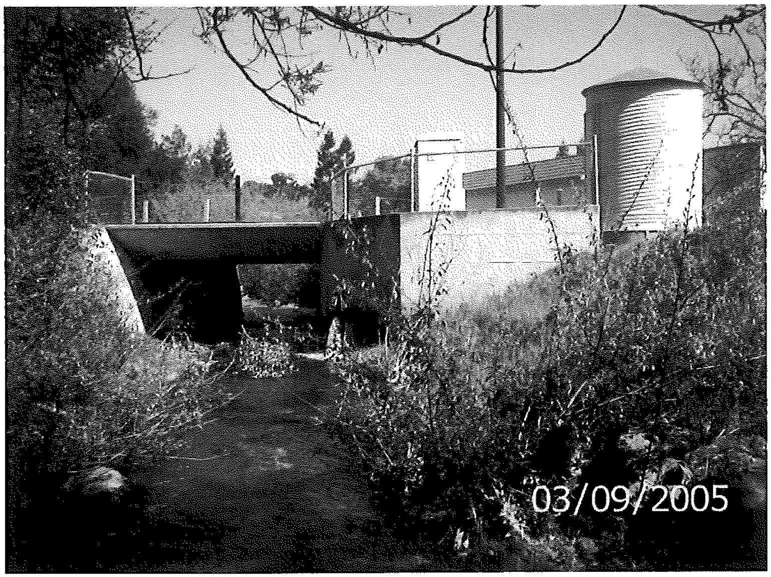


Figure 6-8: UPRR (looking from upstream)

Rights of Way

TCE's would be needed for access to replace the bridge at the UPRR. The District coordinated with UPRR early in the planning stages of the new bridge. The new bridge would be an improvement for the UPRR, and they are expected to provide the TCE's necessary for the construction of the flood protection work at that site. The TCE's needed are shown in Figure 6-9. In addition to TCE's, permanent easement will be need from the UPRR to maintain the channel below the new bridge.

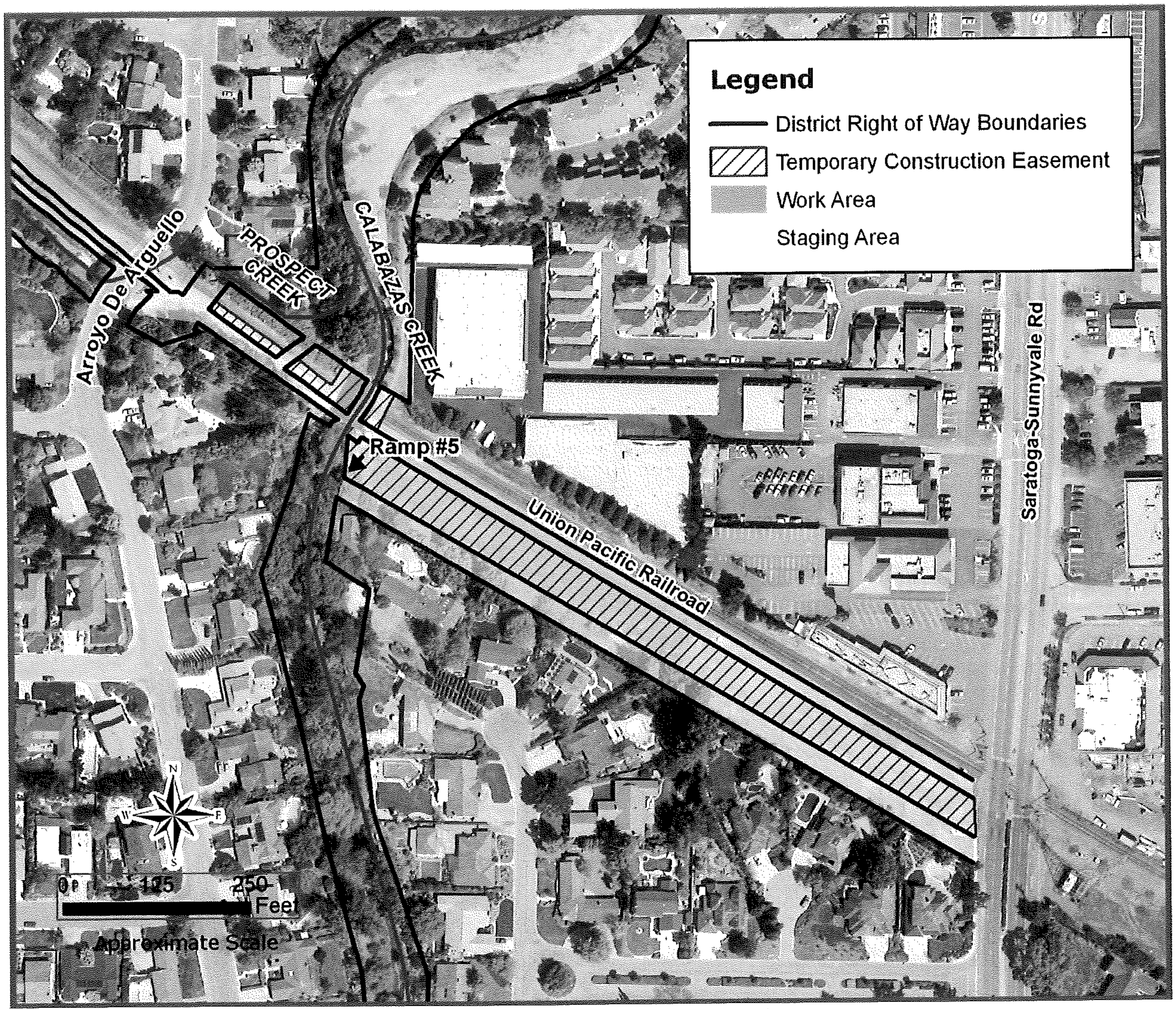


Figure 6-9: Required TCE

Construction Staging and Access

The UPRR operates a freight train on this bridge on a regular basis. The District has coordinated with the UPRR to arrange a 2 day construction window for all work necessary to replace the existing tracks with new tracks on a new bridge. This will allow bridge replacement without the expense of a shoofly. UPRR trains operate on Wednesdays and Fridays. The new bridge and abutments will be precast for quick installation within the small time frame available. The construction sequence plan is as follows:

Friday:	Regular UPRR train traffic
Saturday:	UPRR removes their tracks
Sunday:	SCVWD removes old bridge
Monday:	SCVWD installs new bridge
Tuesday:	UPRR installs new tracks
Wednesday:	Regular UPRR train traffic

Temporary Construction Easement would be necessary from the UPRR. Staging areas and access are shown in Figure 6-10, “UPRR Staging Areas”. Access would be from both Arroyo De Arguello and Saratoga-Sunnyvale Road.

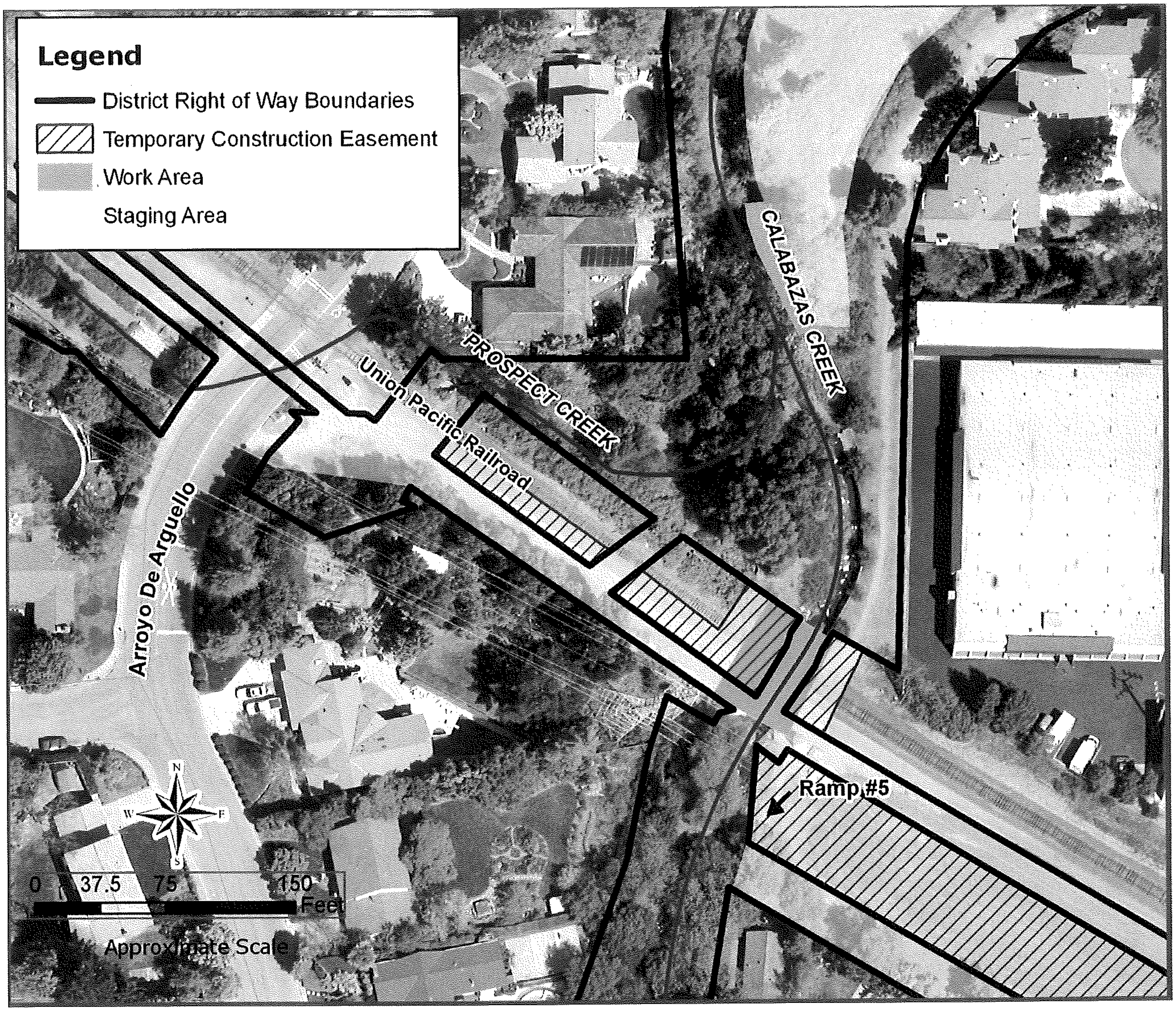


Figure 6-10: UPRR Staging Areas

The UPRR bridge replacement is including wingwall construction and other associated activities would be completed in a 6 month window.

6.3 EROSION PROTECTION

Proposed Erosion Site Locations

Calabazas Creek major erosion sites were identified in Chapter 3 of this Report and illustrated in Table 3-1, "Erosion Repair Sites". Chapter 5 explained how the erosion repair sites were selected by the District engineers. In this chapter, erosion site access is discussed along with additional detailed information on the erosion site repair.

Fourteen erosion sites selected for repair and the access ramps are shown in "Figure 6-11, Erosion Repair Sites".

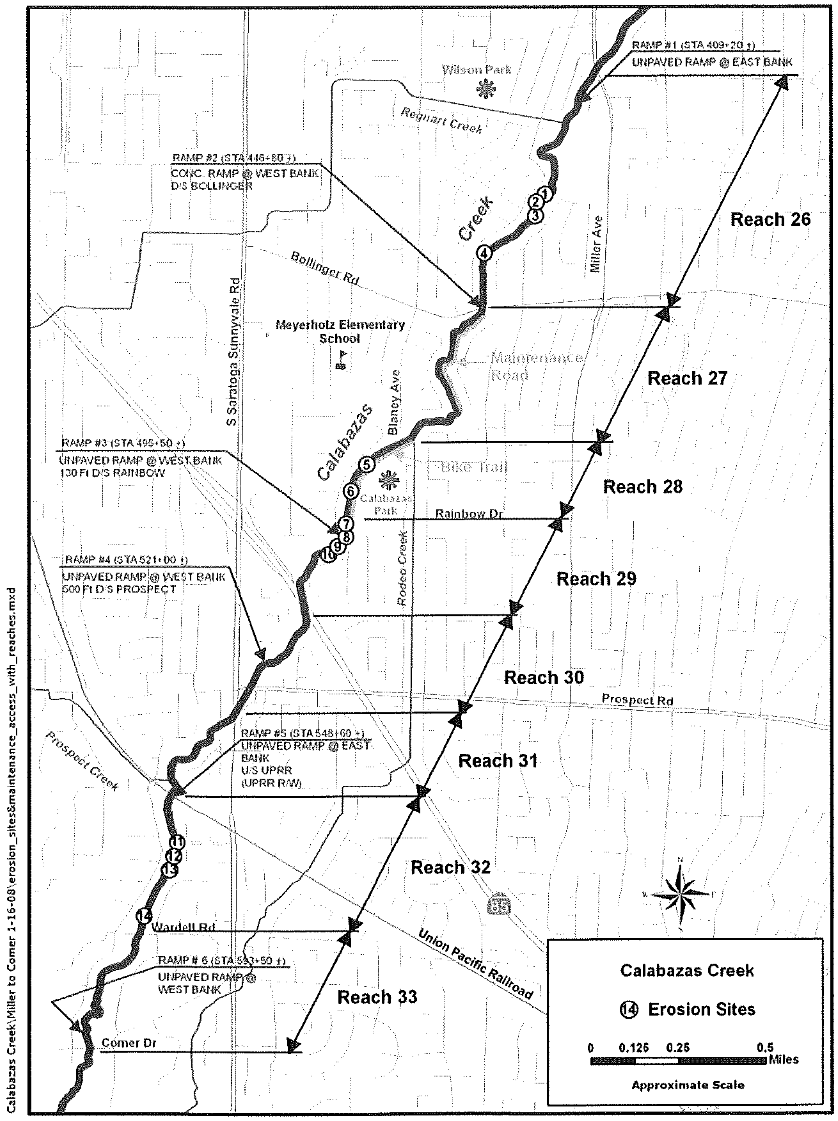


Figure 6-11: Erosion Repair Sites

Proposed Erosion Protection Measures

For sites where erosion has cut out the toe and a portion of a steep bank and there is no room for shaping back the bank slope. Log mattress would be used for bank repair. Log mattress is a stack of logs that forms the protected bank slope with soils filled the cavity behind the logs. Each individual log is anchored to the foundation. The logs would be cut to fit the size of the eroded bank. There would be minimal excavation except to clear away debris and loose materials. Exposed live tree roots would be saved, as much as possible, by burying them in the soil backfill. A cross-sectional view of a log mattress bank protection is shown in Figure 6-12.

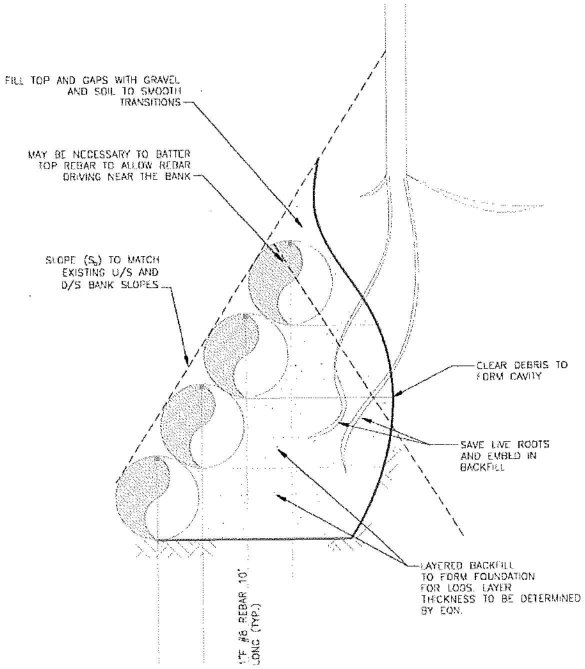

FILL TOP AND GAPS WITH GRAVEL AND SOIL TO SMOOTH TRANSITIONS
MAY BE NECESSARY TO BATTER TOP REBAR TO ALLOW REBAR DRIVING NEAR THE BANK
SLOPE (S_b) TO MATCH EXISTING U/S AND D/S BANK SLOPES
CLEAR DEBRIS TO FORM CAVITY
SAVE LIVE ROOTS AND EMBED IN BACKFILL
LAYERED BACKFILL TO FORM FOUNDATION FOR LOGS. LAYER THICKNESS TO BE DETERMINED BY EOR.
1"F #8 REBAR 10' LONG (TYP.)

Figure 6-12: Sectional Profile of a Log Mattress Protection

Rock Slope Protection would be used to protect and stabilize embankment soils from the erosive forces of flowing water and piping forces resulting from groundwater seepage. A well-engineered riprap system would consist of:

- A filter layer of gravel or fabric designed to prevent soil movement into or through the riprap layer while allowing water to drain from the embankment.
- A stone layer of appropriate gradation and thickness to resist the shearing forces of the flow.

This bank protection method would be appropriate for medium- to high-velocity (greater than 6 feet per second) flows. Vegetation would be included. See Figure 6-13 for a sketch of this technique.

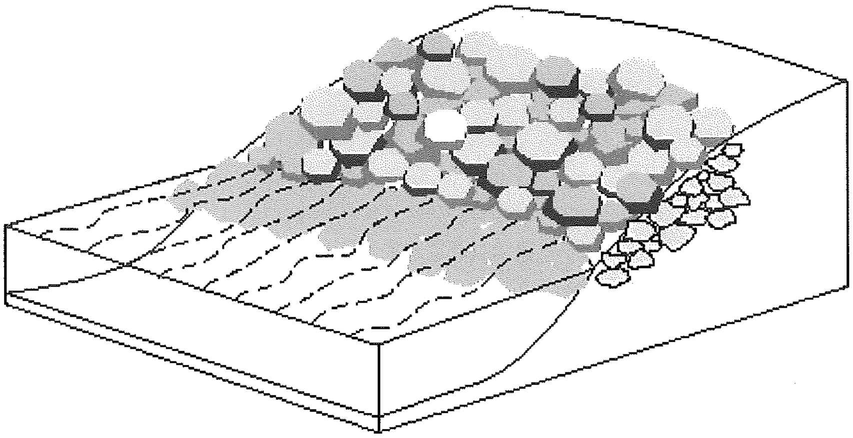


Figure 6-13: Boulder Toe Protection

However, Rock Slope Protection is categorized as a mild-slope protection technique. The maximum bank slope is limited to 1.5H : 1V. The eroded bank would need to be shaped back to allow sufficient space to install the riprap and to conform to an as-built slope that does not encroach into the flow area.

Edge treatment would be extremely important during construction. Filling the gaps between riprap and neighboring slopes would avoid eddy erosion that may undermine the riprap in the future.

It would be possible to incorporate vegetation into the riprap project, if the site conditions allow for long term survival of the plant species. The plants used would be selected by a botanist knowledgeable of native plants, taking into account site conditions such as soil types, local vegetation, and water availability.

Reach 26 Erosion Sites

Site #1

Site #1 extends from Station 424+22 to Station 424+44. It consists of a 20-foot high bank along 22 feet of channel on the east bank. There are isolated areas of possible slope failure. The upper bank is nearly vertical and bare. Groundcover is recommended on the upper bank. The lower bank would be protected on 1:1 slope using a log mattress installation. The downstream edge borders 3 cottonwood trees at toe line. These trees would remain. Vegetation Management trims these trees regularly. See Figure 6-14, "Erosion Site #1" below.

Site #2

Site #2 extends from Station 424+96 to Station 425+15. It consists of 20-foot high banks along 19 feet of channel on the east bank. The lower 8 feet needs protection because of severe erosion. Groundcover would be planted to protect the bare soil on upper slope. See Figure 6-15, "Erosion Site #2" below.

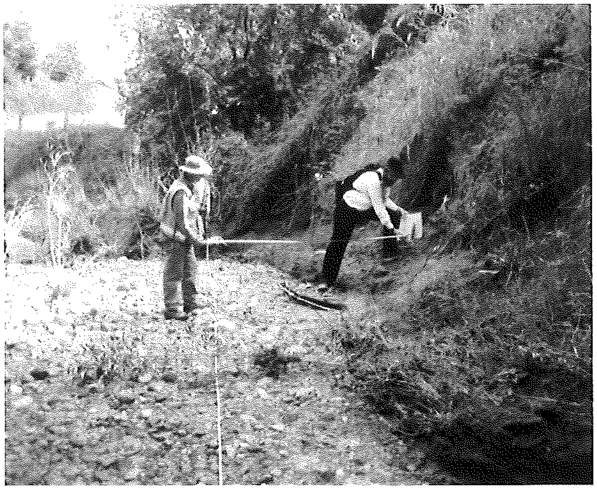


Figure 6-14: Erosion Site #1

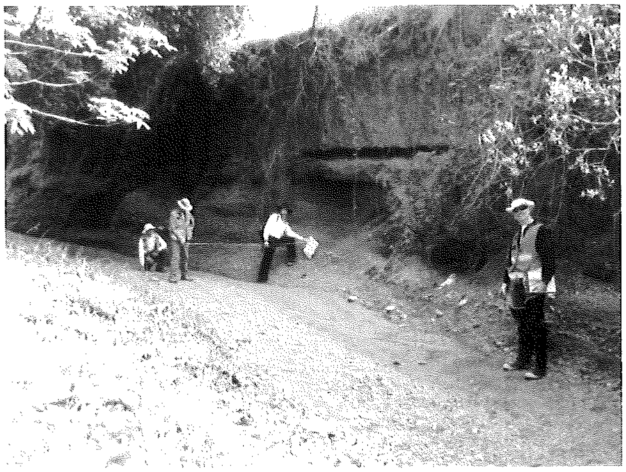


Figure 6-15: Erosion Site #2

Site #3

Site #3 extends from Station 428+75 to Station 428+87. Toe erosion is severe along 12 feet of channel. The eroded pocket would be filled with soil and lined with quarry rocks. Ground cover is recommended along the upper banks to provide slope protection.

Site #4

Site #4 is at the concrete outfall at Station 439+00 and is currently covered with a blue tarp. The tarp covers a 12" storm drain which has caused severe erosion directly below the outfall. The erosion pocket is 9 feet high, 9 feet deep and 2 feet long. The erosion pocket would be filled with angular rocks. The tarp would be permanently removed.

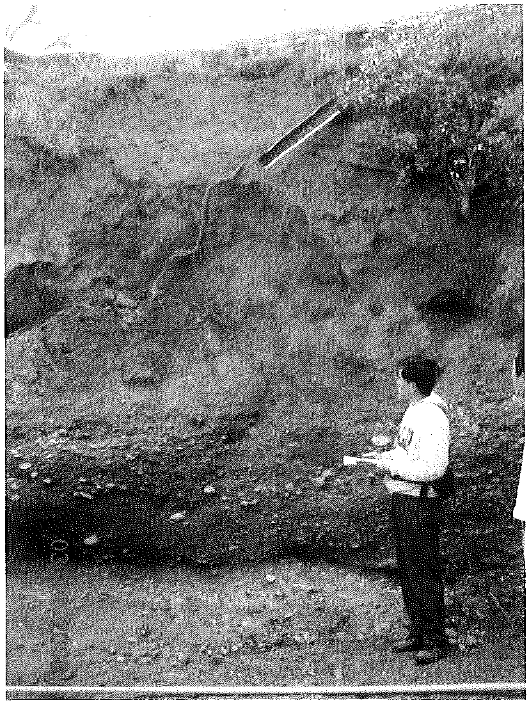


Figure 6-16: Erosion Site #3

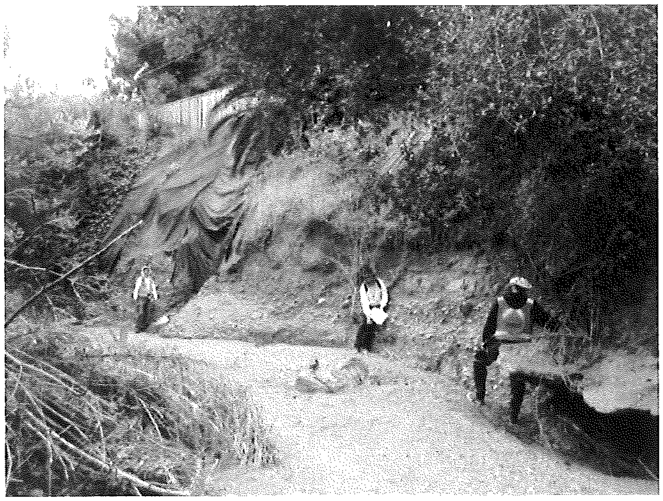


Figure 6-17: Erosion Site #4

Reach 28 Erosion Sites

Site #5

Site #5 extends from Station 484+49 to Station 484+85. The east bank has eroded to expose roots of 4 oak trees at the top of bank. The site is approximately 36feet long. Log mattress protection is recommended to protect the steep banks. A 5-foot long section of bank upstream from the log mattress would be filled with soil and rock. Upstream from this site, the west bank is protected by geocells. Several dead and live willows near bottom of geocells have been the cause of significant downstream erosion and would be removed.

Site #6

Site #6 extends from Station 488+96 to Station 489+26. Stream flow has shed off loose rocks upstream to cause erosion of this site, exposing the roots of an oak tree. Soil and rock protection to a 1:1 slope would be installed along this 30-foot long erosion site to an elevation of approximately 6 feet.

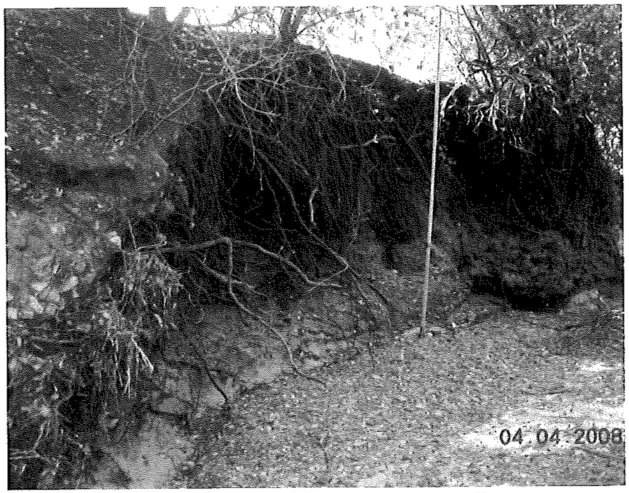


Figure 6-18: Erosion Site #5

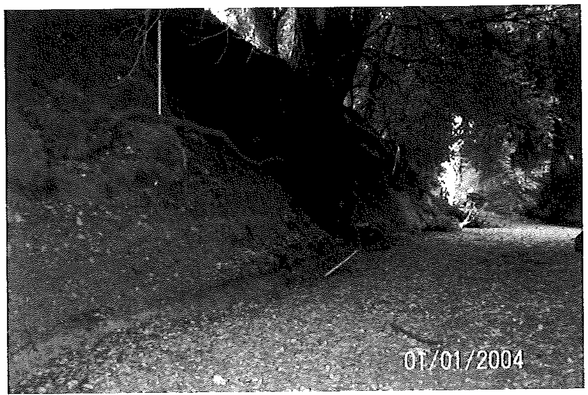


Figure 6-19: Erosion Site #6

Reach 29 Erosion Sites

Site #7

Site #7 extends from Station 494+57 to Station 494+67. Erosion has occurred just upstream of concrete sacks on the east bank. The eroded 3'x4'x3' hole near the toe of the existing sacks would be filled with rock. The repair at this site would include adding rock along a 10' long section of channel to a height approximately 5 feet above the invert.

Site #8

Site #8 extends from Station 497+12 to Station 497+23 and is located behind the Cupertino Creekside Condominiums. Erosion exists around the outside bend. Work would entail removal of several dead tree trunks. A 15-foot long section of channel would be protected with rock to an elevation of 8 feet above the invert. Angular rocks would be used to ensure rock stability on a slope of 1:1.

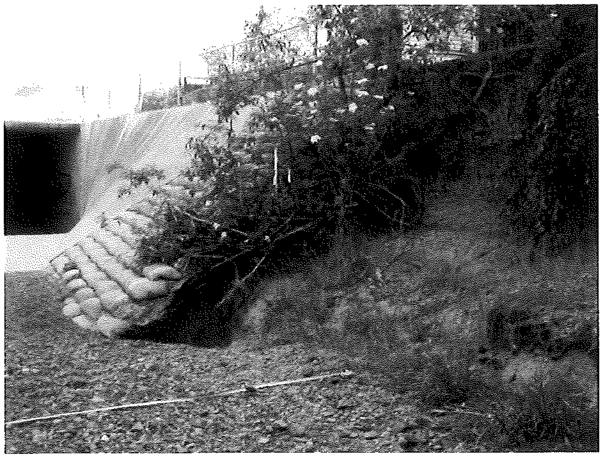


Figure 6-20: Erosion Site #7

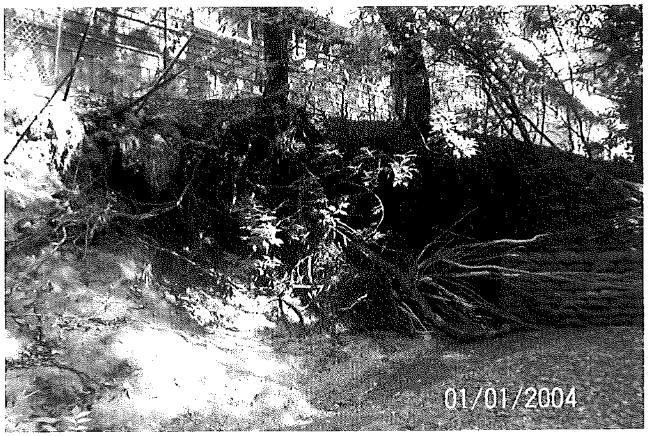


Figure 6-21: Erosion Site #8

Site #9

Site #9 extends from Station 497+65 to Station 498+04, which is located just upstream from Site #8. A bent willow tree in channel affects flow capacity and would be removed. Approximately 37 feet of channel would be repaired with angular rock to an elevation 6 feet above the invert. The downstream limit of this repair is at an oak tree where rock would be placed carefully in order to protect this tree. The rock slope protection at this site would be installed to a 1:1 slope.

Site #10

Site #10 is on an outside bend from Station 498+15 to Station 498+39. This 56-foot long section of channel currently has a 5-foot deep pocket which would require rock and soil fill. Rock would be installed with a 1:1 side slope to an elevation of 6 feet above the invert. The toe line is staked in the field. The foundation of rock riprap would be installed 2 feet below the channel bottom to cover the additional scour potential of the outside bend.

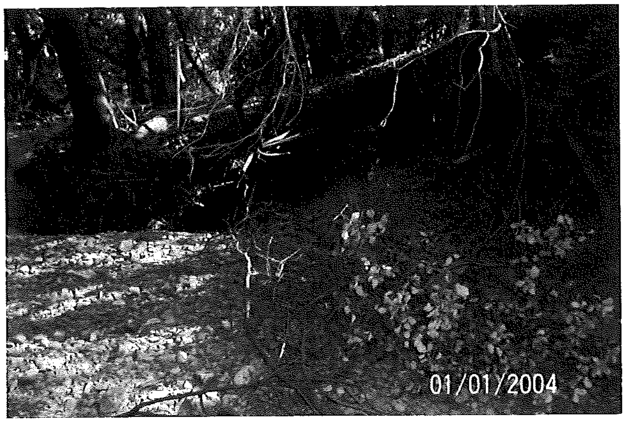


Figure 6-22: Erosion Site #9

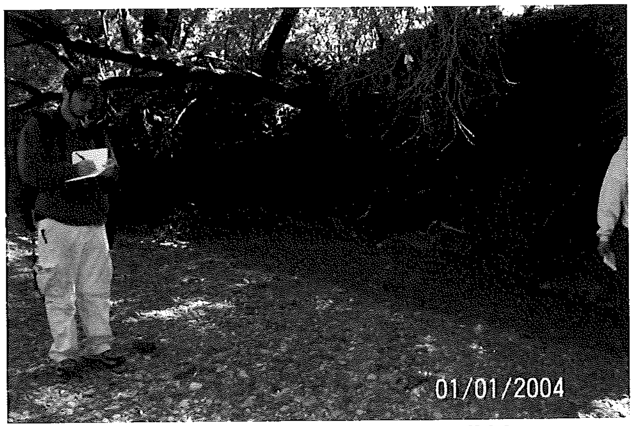


Figure 6-23: Erosion Site #10

Reach 32 Erosion Sites

Site #11

Site #11 is a result of eddy erosion off the edge of concrete sacks. The site extends from Station 556+65 to Station 556+75. The repair would include the installation of angular rock at a 1:1 slope to an elevation of 7 feet above the invert. This 10-foot long section begins at the existing sacked concrete and ends at the bottom of an oak tree.

Site #12

Site #12 extends from Station 558+40 to Station 558+60. Erosion on the west bank was caused by flow shedding off a volunteer willow tree in channel bottom. It is proposed to remove the willow tree and line the channel bank with rocks up to the 4" plastic drain pipe.

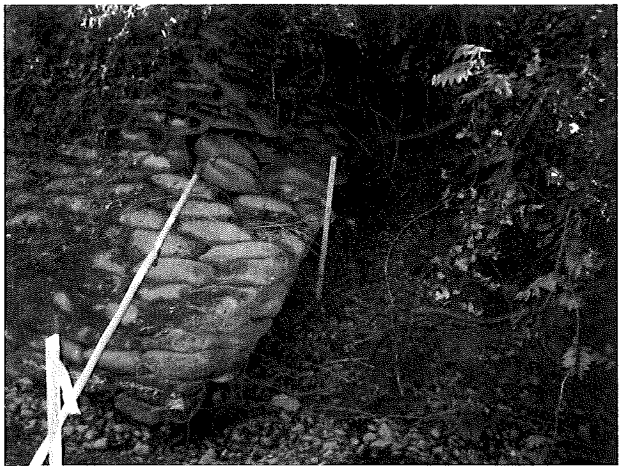


Figure 6-24: Erosion Site #11

Figure 6-25: Erosion Site #12

Site #13

Site #13 extends from Station 558+85 to Station 559+00. The west bank is eroded up the top of bank, which is approximately 9 feet above the invert. Existing concrete rubble was used in the past to stabilize the bank. The proposed repair would include the removal of concrete debris, rock-riprap of the bank surface and revegetation. The isolated erosion holes would be filled with soil. Cottonwood cuttings would be planted approximately 3 feet above the invert.

Site #14

Site #14 is a failed concrete sack structure around a 30" storm drain pipe between Stations 567+89 and 567+97. All of the existing sacked concrete would be removed. The bare channel soils would then be armored with angular rock slope protection at a 1:1 slope. The top of the proposed rock would be level with the top of the outfall, which is approximately 6 feet above the invert.

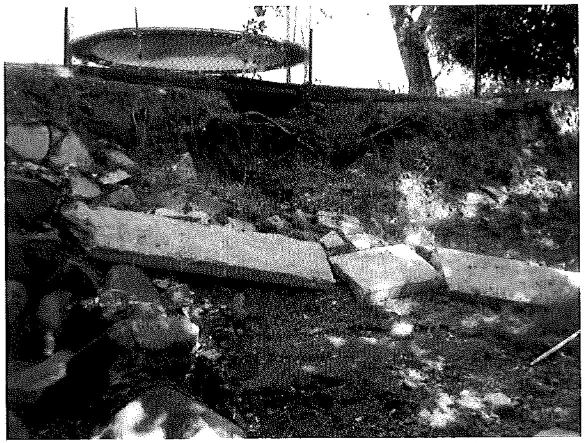


Figure 6-26: Erosion Site #13

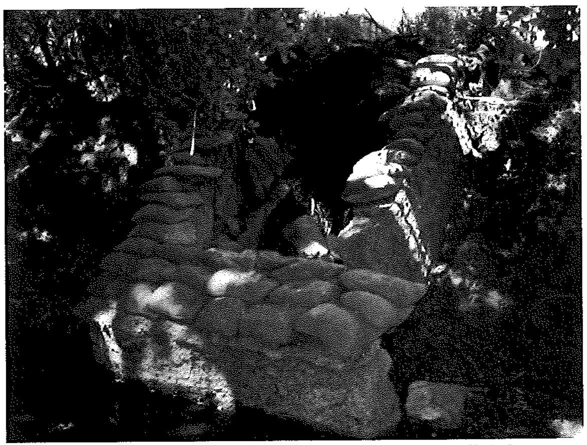


Figure 6-27: Erosion Site #14

Miscellaneous Channel Work

Several items of work that require a contractor to perform work under the direction of a field engineer are listed below.

A reach extending approximately from Station 456+85 to Station 458+20 is littered with concrete debris and failed rock riprap. Rocks and concrete pieces have redirected flows and caused erosion of banks. Steel rebars protrude from broken pieces of concrete rubble. These protruding rebars are a hazard to personnel working in the channel in addition to catching debris flowing downstream. This proposed work would include cutting the protruding rebars, removing concrete debris, reinstalling rock riprap, and reshaping the channel geometry and excavating a portion of the point bar to Station 458+20 to widen the channel bottom to 20'. See Figures 6-28 and 6-29 below.

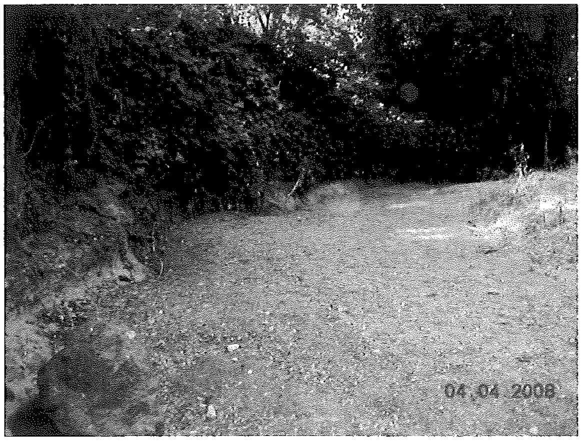


Figure 6-28: Approx Sta 456+80 looking upstream

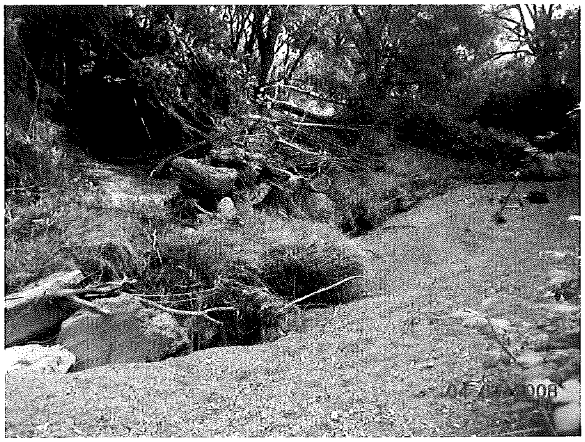


Figure 6-29: Approx Sta 458+20 looking downstream

At station 433+00, concrete debris would be removed. At station 440+80, an eroded 18 inch galvanized storm drain pipe would be cut and the trench would be filled with soil and rock. See Figures 6-30 and 6-31 below.

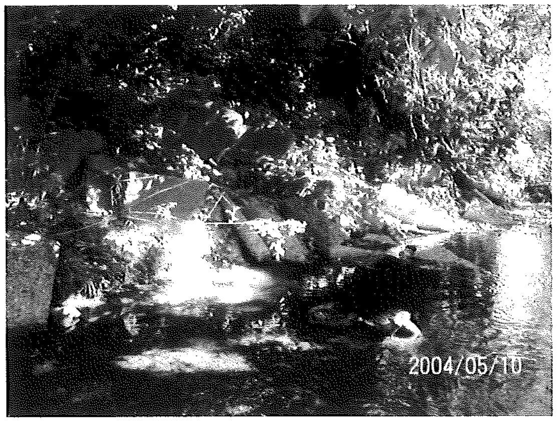


Figure 6-30: Approx Sta 433+00

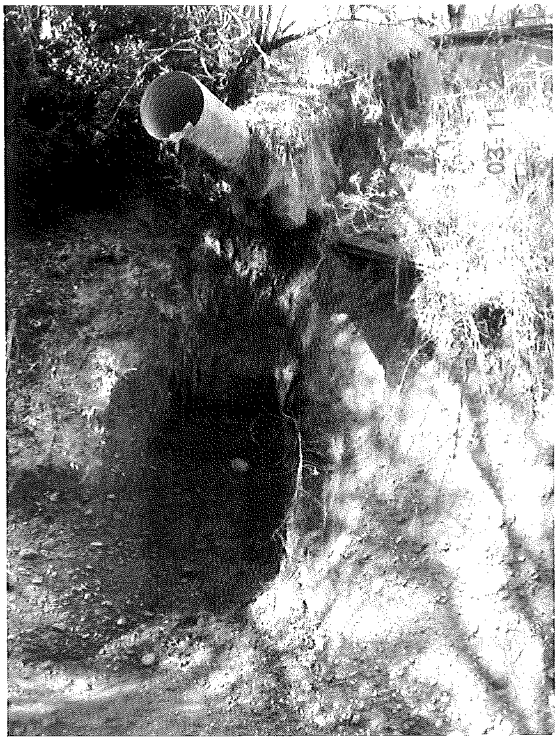


Figure 6-31: Approx Sta 440+80

Rights of Way

The District has adequate rights of way to construct and maintain the proposed erosion protection and miscellaneous channel repairs described in Section 6.1 of this Report. Access to the erosion sites is summarized in Table 6-1, "Erosion Site Access". See Appendix H, "Rights of Way within Project Limits" and the plan/profile sheets in the Plates of this report.

Construction Staging and Access

Although adequate rights of way exist to perform all the erosion and channel work, there is little working room immediately adjacent to the erosion repair sites.

The District owns a large section of open land downstream of Prospect Road that can be used to stockpile rock and log materials needed for erosion repair. This open land is located immediately northwest of the proposed Revegetation Planting enhancement work. See Figure 7-1, "Revegetation Planting Area" for an aerial view of this open land.

Access to the fourteen recommended erosion sites is summarized in Table 6-1, "Erosion Site Access" below.

RCH	**RCH**		**ACCESS (see Figure 6-11 for ramp map)**
	FROM	**TO**	
26	424+22	424+44	Use Ramp #1 or #2
	424+96	425+15	
	428+75	428+87	
	438+99	439+01	
28	484+49	484+85	Easy top of bank access within Calabazas Park, but a ramp would need to be cut down into the channel.
	488+96	489+26	
29	494+57	494+67	Ramp #3 off Rainbow Drive can be used. Removal of a 10 inch diameter oak tree limb would be necessary if equipment over 6 feet high is needed for erosion work. See Figures 6-34 and 6-35
	497+12	497+23	
	497+65	498+04	
	498+15	498+39	
32	556+65	556+75	Use Ramp #5
	558+40	558+60	
	558+85	559+00	
	567+89	567+97	

Table 6-1: Erosion Site Access

Note that the table above doesn't address the channel work described in "Miscellaneous Channel Work" in this section of this Report. Access to the area between Stations 456+85 and 458+20 would need to be accomplished by entering the channel in the Calabazas Park area (Reach 28) and traveling downstream with equipment and supplies through the box culvert under Blaney Avenue to Reach 27.

All of the existing ramps, except Ramp #2 (see Figure 6-31) at Bollinger Road, are unpaved and require some work to make them more usable. Ramp #1 can be accessed through Creekside Park. The large chain link fence swing gates at Ramp #1 in Creekside Park (see Figure 6-30) may allow channel invert access for medium sized construction equipment.

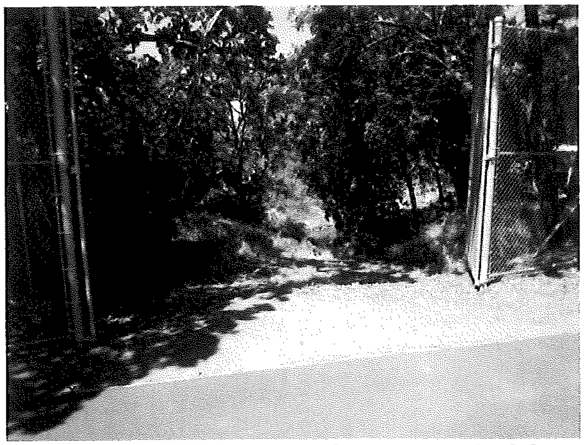


Figure 6-32: Ramp #1 at Creekside Park

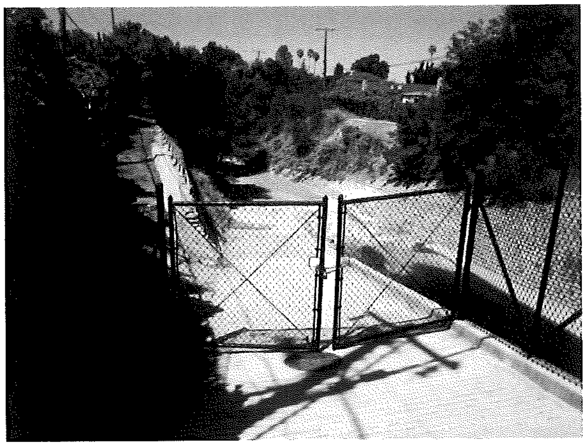


Figure 6-33: Ramp #2 at Bollinger Road

Ramp #3 (see Figures 6-33 and 6-34) is blocked by a large diameter oak tree limb protruding vertically approximately 5 to 6 feet above the entire ramp entrance. It is recommended that this limb be removed not only for work at Erosion Sites 7, 8, and 10, but also for future ongoing maintenance of Calabazas Creek upstream of that ramp.

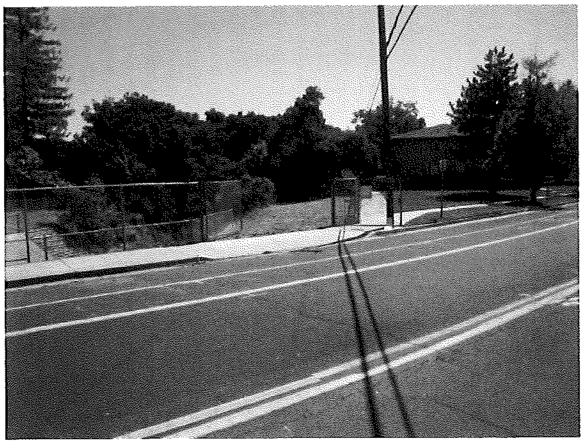


Figure 6-34: Ramp #3 entrance at Rainbow Drive

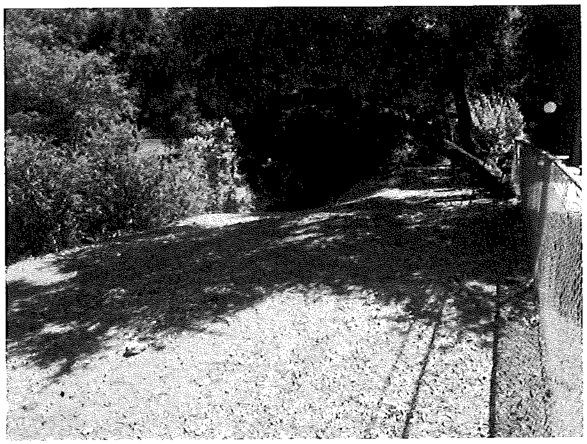


Figure 6-35: Tree obstruction at Ramp #3

Ramp #5 (see Figure 6-34) adjacent to the UPRR is very narrow, but may be widened as necessary to allow access to erosion sites 11, 12, 13 and 14 in reach 32.

Ramp #6 (see Figure 6-35) is accessible through a large metal swing gate as seen in Figure 6-35 below. Minor grading work will be necessary to enter the channel from Ramp #6 in the Comer Debris Basin area.

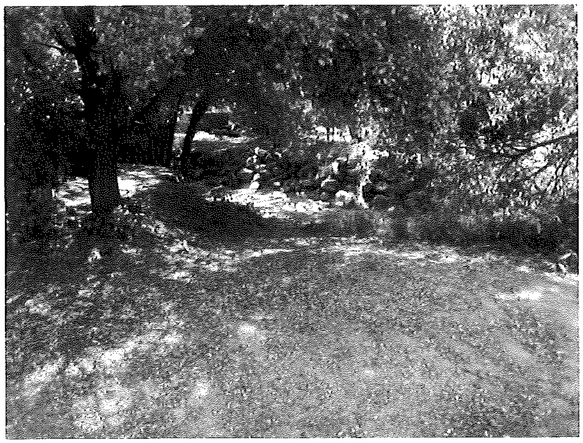


Figure 6-36: Ramp #5 upstream of the UPRR

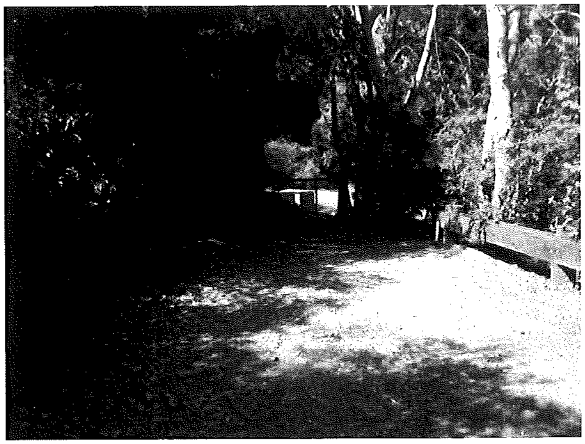


Figure 6-37: Ramp #6 near the Comer Debris Basin

Photos of Ramp #4 are not provided since this ramp (downstream of Prospect Road) is not recommended for use.

CHAPTER 7 – POTENTIAL ENVIRONMENTAL ENHANCEMENTS

In addition to flood and erosion project work described for the recommended project in Chapter 6, two feasible channel enhancements, outlined in this chapter, are identified for Board consideration.

7.1 REVEGETATION PLANTING

Vegetation Planting

The District holds in fee title about 1 acre of land on the northwest side of Calabazas Creek about 500 feet downstream of Prospect Road. This channel enhancement entails the installation of approximately 3,800 square feet of vegetation in the area shown below in Figure 7-1, "Proposed Planting Area".

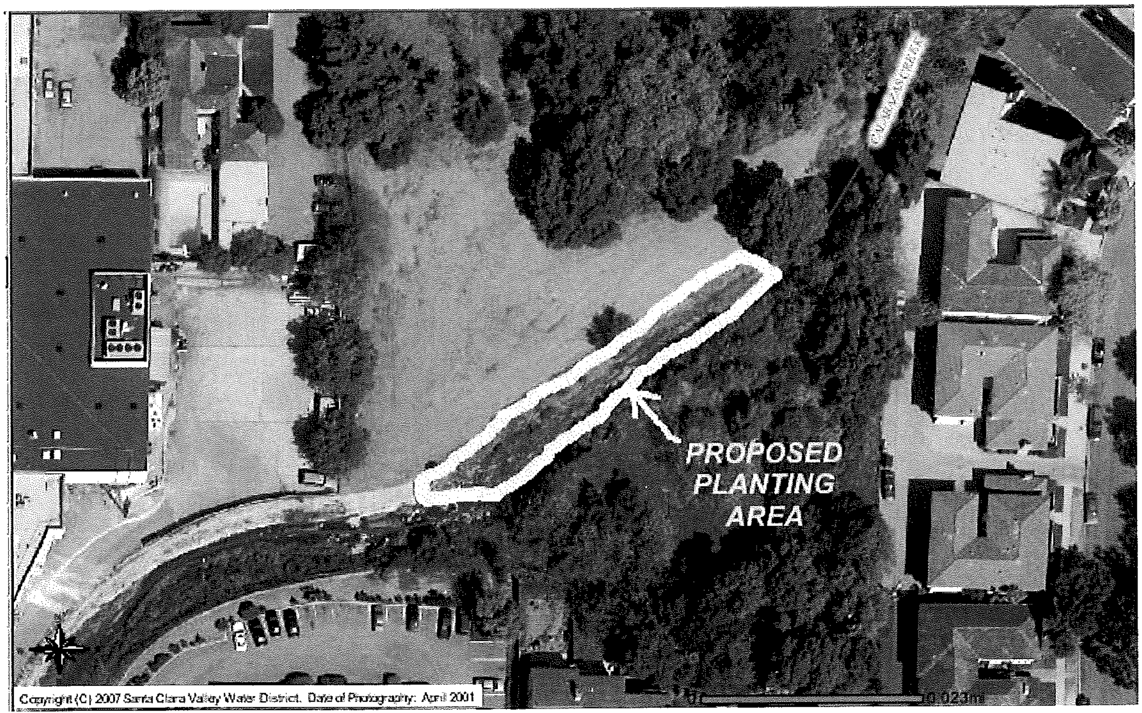

PROPOSED
PLANTING
AREA
0.023mi
Copyright (C) 2007 Santa Clara Valley Water District. Date of Photography: April 2001

Figure 7-1: Revegetation Planting Area

The area outlined in the diagram above currently has low value shrubs. The proposal is to plant the toe of the creek (about 1,000 square feet) with willows. Along the upper banks, the remaining 2,800 square feet could be planted with buckeye, coast live oak and elderberrys.

Rights of Way

The District has adequate rights of way to construct and maintain the proposed revegetation planting. See Appendix H, "Rights of Way within Project Limits" and the plan/profile sheets in the Plates of this report. All of the revegetation work is on District owned lands.

Construction Staging and Access

This work would not require a large staging area. However, all of the open land to the northwest side of the planting area is owned by the District and may be used to stage the planting work.

Access to the site would be through the back of the shopping center area at the northeast corner of Prospect Road and Saratoga-Sunnyvale Road. An unpaved access ramp (ramp #4) near station 521+00 is very close to the revegetation site for easy channel bottom access. See Figure 6-11 for the location of this ramp. Adequate District easements exist between Prospect Road and the revegetation site.

7.2 COMER DAM MODIFICATION

Comer Dam Removal & Step Pool Installation

The Comer Dam Modification enhancement would involve removing the top 50% of the dam, which is shown in Figure 7-2, "Comer Dam" below.

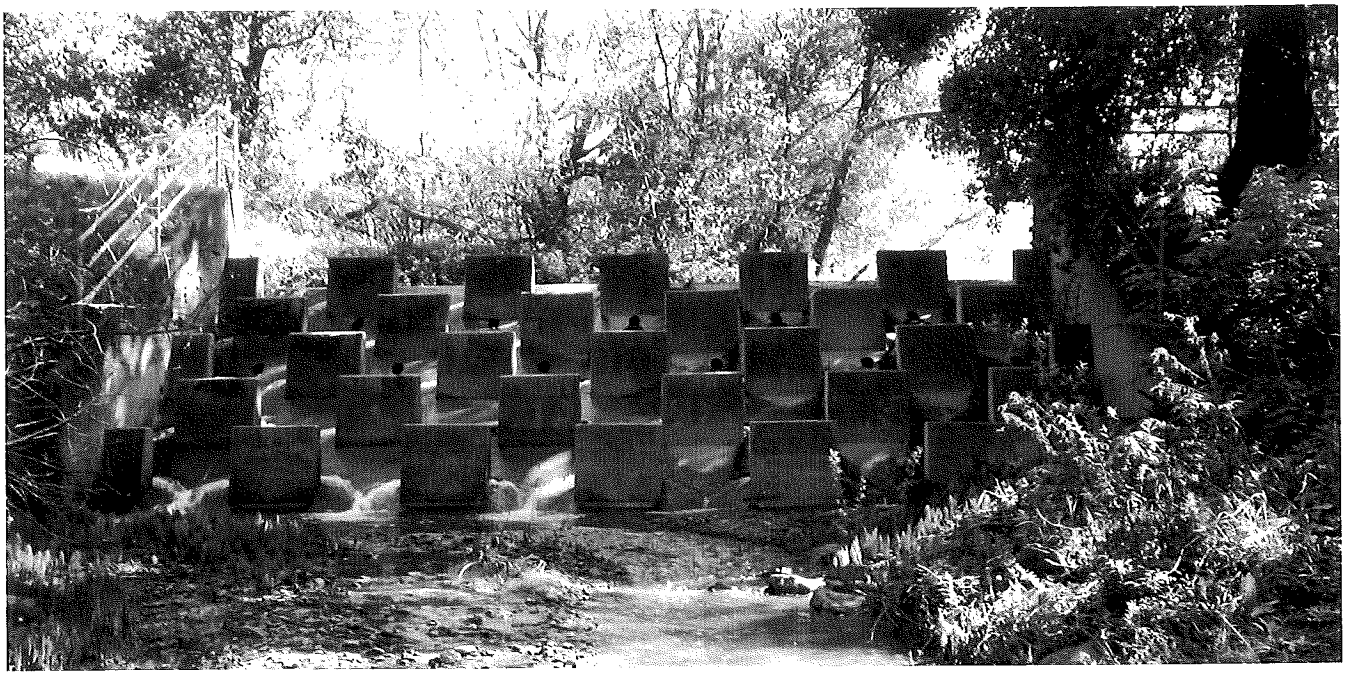


Figure 7-2: Comer Dam

The channel invert would be modified by the installation of a series of small drop structures as shown in the creek profile view in Figure 7-3, "Comer Dam Creek Profile" below.

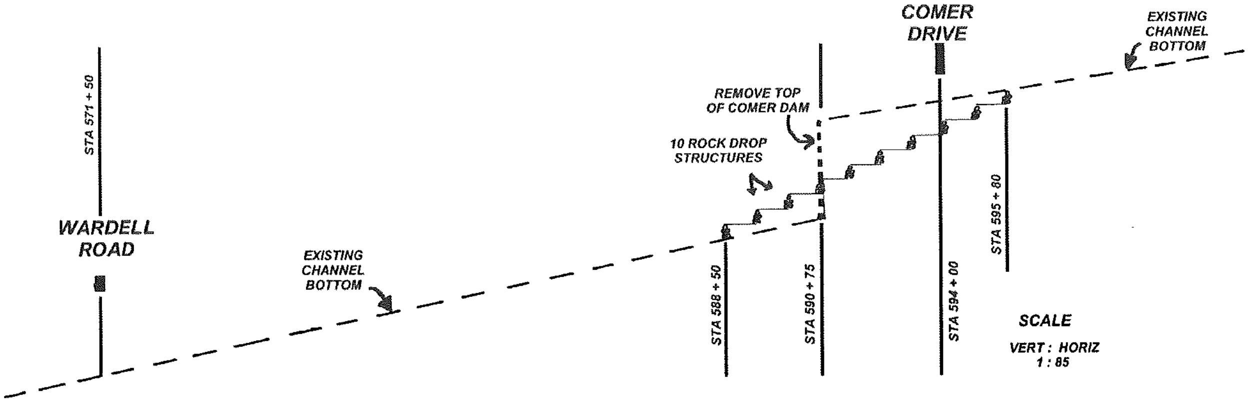


Figure 7-3: Comer Dam Creek Profile

The design includes:

- Channel realignment upstream of Comer Dam
- Construction of 10 drop structures with drop heights approximately 11 inches and distances between each drop ranging from 60 feet to 170 feet.

The design would impact the channel area approximately 250 feet downstream of the dam and approximately 500 feet upstream of the dam. The drops would be placed away from bends in the creek's path. The design slope between drops is approximately

1-percent. The drops themselves would be constructed of rock. Downstream of each drop, a pool is constructed to dissipate energy during low flows. The channel bed between drop structures would be constructed with an armoring layer of small gravel similar to that which exists upstream of the dam. The cross-sectional shape of the channel was developed to match similar cross sectional channel geometry in stable channel reaches upstream.

Rights of Way

Adequate rights of way exist for all Comer Dam Removal work with the exception of minor channel work upstream of Comer Drive. As shown in Figure 7-4, minor TCE's would be needed to construct the most upstream step pools. The exact dimensions of the right of way required will need to be verified since the right of way lines shown in Figure 7-4 are taken from the SCVWD's year 2001 GIS database and have limited accuracy. The Comer Dam Modification enhancement area can be accessed easily through a District gate off Comer Drive, which is within a District easement. See Appendix H, "Rights of Way within Project Limits" and the plan/profile sheets in the Plates of this report.

Construction Staging and Access

The Comer Debris Basin immediately upstream of Comer Dam is a large open space, all of which is within District rights of way. This area can be used as a staging area for equipment and materials as shown in Figure 7-4 below.

Comer Drive is a narrow two lane road in a quiet Saratoga neighborhood. Excessive traffic or noise would be an issue with local residents. The work will need to be staged in a manner that will keep both lanes of traffic open at all times. Materials and supplies will need to be brought in using vehicles small enough to enter the staging area through the Ramp #6 and be turned around within District rights of way within the Comer Debris basin area. See Figure 7-4 below for an aerial view of the construction and staging areas.

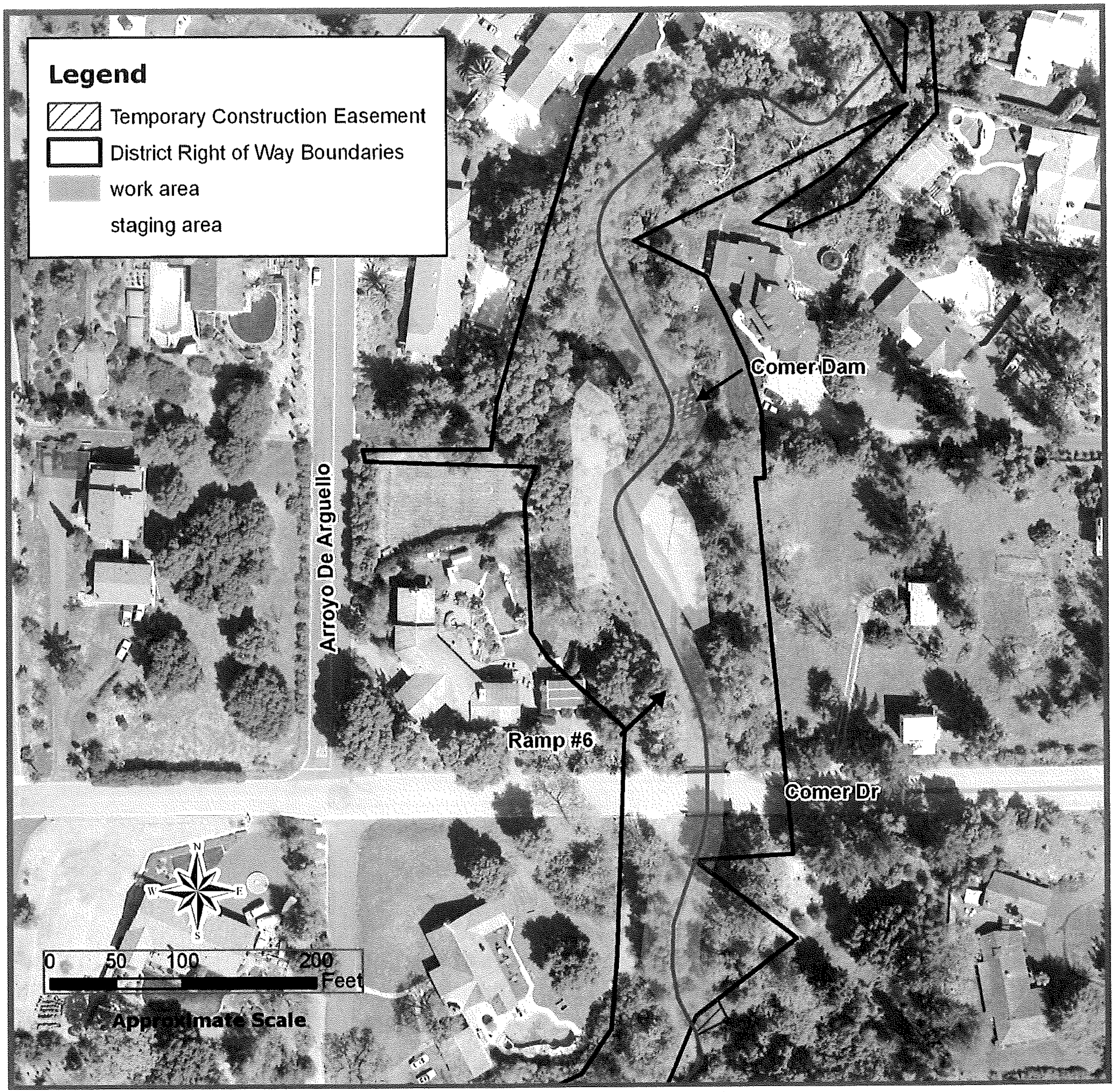


Figure 7-4: Comer Dam Work and Staging areas

CHAPTER 8 – OPERATION AND MAINTENANCE PROGRAM

The staff-recommended alternative, as described in earlier chapters, will provide Calabazas Creek from Miller Avenue to Comer Drive protection from a 1-percent flood. This capacity for flood protection is based on certain assumptions of channel roughness and cross-sectional areas that are present in the creek today. To maintain this flood capacity, certain operation and maintenance work must be kept to continue the same channel characteristics. This requirement for operation and maintenance is described in the following.

8.1 ROUTINE INSPECTION

The twice yearly inspection of the creek that is being performed by the West Valley Watershed Field Operations Unit of the District is sufficient for routine monitoring. Special attention should be given to the following sites.

Detention Basin Upstream of Saratoga-Sunnyvale Road

The proposed project work includes converting an existing swale between Saratoga-Sunnyvale Road and the UPRR into a detention basin. A 1-foot-diameter outlet pipe near station 533+95 is designed to release water from the swale back into Calabazas Creek at a slow rate following the storm. Regulations require that the ponded water be drained in 48-72 hours.

It is essential that the outlet pipe be free from debris clogging. The existing swale is covered in short-to-medium-size grasses. Large woody debris is not expected to be present often. It is preferable that one of the 2 yearly inspections occurs just before the storm season, and that an inspection takes place right after a major storm that has overflowed into the detention basin. Trash and sediment, if any, should be removed from the outlet pipe. The overflow weir would require periodic cleaning to remove leaves and other debris.

Erosion Sites

There are two types of proposed erosion repair in Calabazas Creek. One uses tree logs and the other rock riprap. The log mattress is composed of approximately-1-foot-diameter logs, anchored by 1-inch-diameter rebars, lining the channel bank with soil backfilling gaps between the logs and bank. Planting spaces are provided between staggered log sections to promote long-term tree growth.

Routine inspection should ensure that the logs are securely fastened to the ground. The transition between natural bank and log section should be smooth. Loose log sections should be tightened, and lost gravel in transition sections should be refilled. The logs are expected to have a typical life of 15-20 years in our environment. Should some deteriorate before the planted trees could take over bank protection, the log sections should be replaced.

The rock riprap is designed to withstand the shear stress of the flood flow without movement. Should some rock pieces move or tumble down from the slope, they should be replaced. Loose rocks on the channel bottom will redirect flow; shed eddies, and cause undesirable erosion.

8.2 VEGETATION MANAGEMENT

The two main vegetation management tasks are listed below:

1. Maintain channel capacity with the same "in-channel" growth level
2. Maintain sufficient growth at erosion sites

The first task is to maintain the same level of in-channel tree growth. When trees within or near the channel bottom become overgrown, they encroach into the flow area and reduce the conveyance efficiency of the channel. Overgrowth of trees isn't a serious problem for most of Calabazas Creek within the project limits. However, Figure 8-1 shows areas of concern where freeboard during large storms is minimal. Maintenance crews should give special attention to potential vegetation overgrowth in all those areas and follow the guidelines as depicted in Figure 8-1 "Limited Freeboard Locations".

REACH	SITE LOCATION	MAINTENANCE REQUIREMENTS
Blaney Ave - Rainbow Dr.	800 ft u/s of Blaney (Sta 486+77 to 488+73)	Annually cut back willows in the flow area - especially those protruding from the geoweb
Rainbow Dr - Hwy 85	190 feet U/S of Rainbow (Sta 495+65 to 496+64)	Annually cut back willows in the flow area - fallen limbs/trees should be removed
Saratoga-Sunnyvale Rd to UPRR bridge	390 to 690 ft upstream of Sar/Sunny Rd (Sta 535+90 to 538+83)	Annually cut back willows and other vegetation from the flow area
	110 to 320 ft d/s of UPRR (Sta 545+34 to 547+35)	Annually cut back willows and other vegetation from the flow area
UPRR - Wardell Rd	90 to 680 ft u/s of UPRR (Sta 549+41 to 555+28)	Annually cut back willows and other vegetation from the flow area
	690-1,090 ft d/s Wardell (Sta 560+45 to 564+41)	Annually cut back willows and other vegetation from the flow area
Comer Dam - u/s Comer Dr	Dam to 200ft u/s Comer (Sta 491+00 to 496+50)	Annually cut back willows in the flow area - fallen limbs/trees should be removed

Table 8-1: Maintenance Guidelines

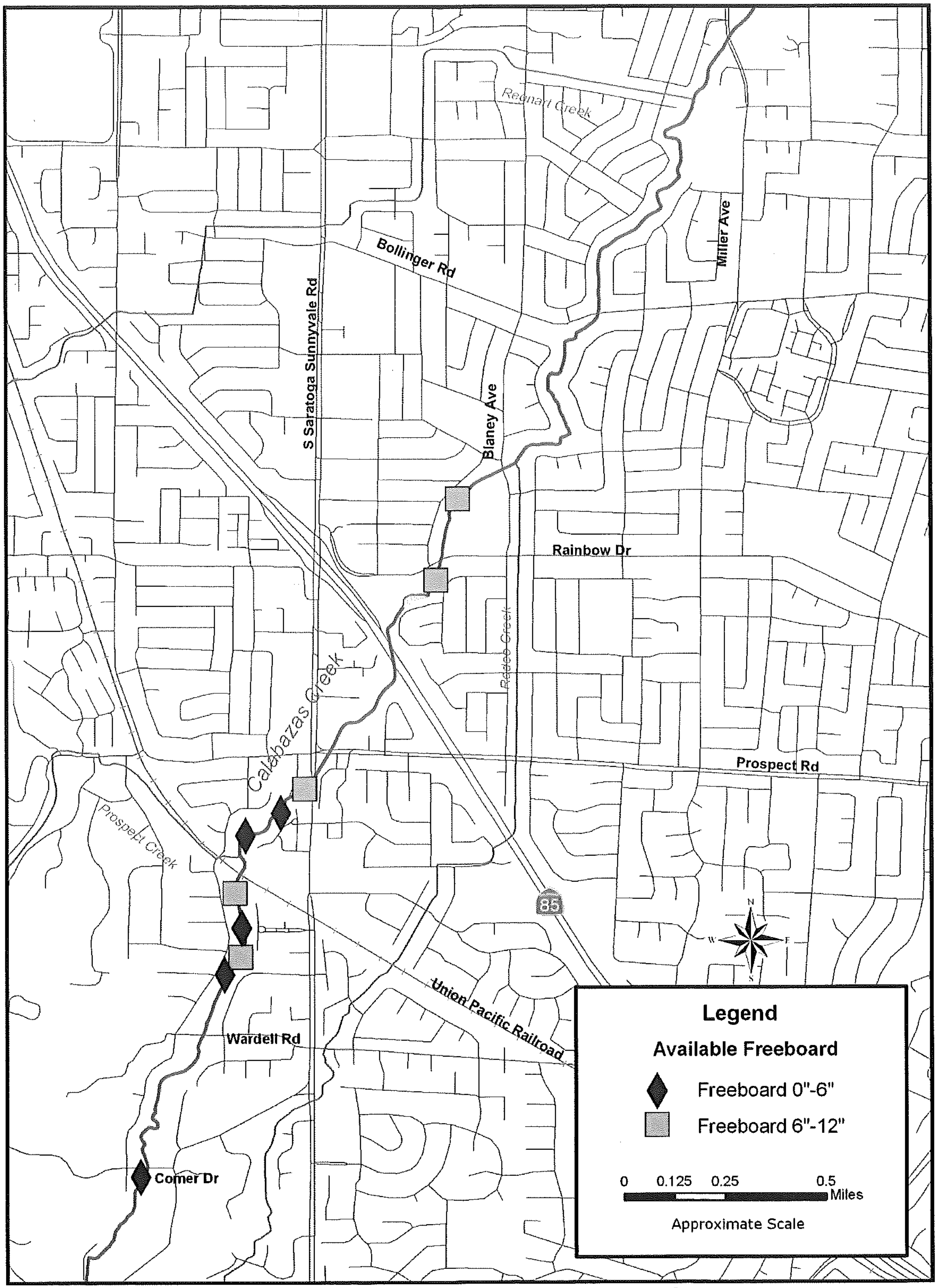


Figure 8-1: Limited Freeboard Locations

The primary vehicle for keeping vegetation growth in check is the annual review of the creek by maintenance personnel. Agreements established with the regulatory agencies for the purpose of this project should include provisions enabling District maintenance personnel to carry out the tasks outlined in Table 8-1, "Maintenance Guidelines"

The problem of vegetation overgrowth isn't limited to causing potential flooding. Vegetation overgrowth can also be the cause of erosion. One example of this is in Calabazas Park just upstream from Rainbow Drive where geocells cover the west bank. The willow trees are proposed to be cut as part of work for Erosion Site #5 described earlier, but maintenance personnel must continue to remove spouting branches in the future. In-channel growth is currently causing serious erosion on neighboring banks at this location.

Another example of vegetation overgrowth inducing erosion is between Bollinger Road and Miller Avenue where patches of Arundo Donex have encroached significantly into the channel invert.

In addition to keeping vegetation growth in check, all other flow obstructions should be removed such as grocery carts, tires or other debris present in the creek within the project limits.

The second vegetation management task entails monitoring and maintaining sufficient growth of the planted trees and groundcover plants at the erosion sites. These plants are essential to the long-term success of the erosion protection work. They are expected to take over the protective function when the logs, coir matting or other biodegradable bank protection materials deteriorate. The plants are provided with dry-water. Routine monitoring, weeding, replenishing of dry-water, and replacement of dead trees are required for this work.

8.3 SEDIMENT REMOVAL

The entire reach of Calabazas Creek from Miller Avenue to Comer Drive is stable under the existing watershed and hydrologic conditions. There is no significant sediment deposition or degradation. The only location where sediment is an issue is in the Comer debris basin dam where sediment accumulation has reduced the clearance under the Comer Drive Bridge to approximately 4 ft.

If the Board approves the proposed enhancement of Comer Dam Modification and restoring the Calabazas Creek in this reach, no future sediment removal would be required.

8.4 MAINTENANCE COSTS

The cost of bi-annual inspection for Calabazas Creek and its tributaries is supported by the General Watershed Fund. The proposed project will not affect the cost of routine inspection noticeably.

Actual maintenance work will be funded by the General Watershed Fund as well. Annual maintenance costs are estimated at $10,000 for the vegetation management

The flood protection components of the project entail the replacement of culverts with similar structures. The maintenance costs of graffiti and other culvert-related maintenance will not increase beyond the present cost level. The erosion control components of the project entail vegetation management and ad hoc maintenance repair.

The Comer Dam Modification discussed as part of potential environmental enhancement in Chapter 7 would reduce maintenance cost by $25,000 annually (2008 dollars).

CHAPTER 9 – PROJECT COST, FINANCING AND CONSTRUCTION

9.1 PROJECT FUNDING

The proposed flood protection and erosion protection work is funded entirely by the Clean, Safe Creeks program. This program was formulated by the District and put out to the voters in the November, 2000 ballot. The voters approved a special tax for the Clean, Safe Creeks program and the Board allotted $35.1 million out of that resource to finance this project.

9.2 PROJECT COSTS

The estimated construction cost of the two recommended flood protection features (Saratoga-Sunnyvale Road culvert and UPRR culvert) is $4.7 million dollars.

The total estimated construction cost for the proposed erosion protection work is $250,000 dollars.

The total estimated planning, design and construction cost of Comer Dam modification is $1.0 million dollars.

The total estimated planning, design and construction cost of the revegetation is $50,000 dollars.

The details for all these costs can be found in Appendix E.

9.3 PROJECT CONSTRUCTION

This section outlines the project schedule and coordination required to complete the recommended project. Discussion of required rights of way, construction staging and access is found in Chapters 6 and 7 for the recommended project (flood and erosion protection) and potential channel enhancements respectively.

Construction Schedule

The estimated construction schedule is provided below in Figure 9-01, “Project Schedule”. The project design began in Fiscal Year 2008. Project construction would begin in Fiscal Year 2010 and would be completed in 1 season.

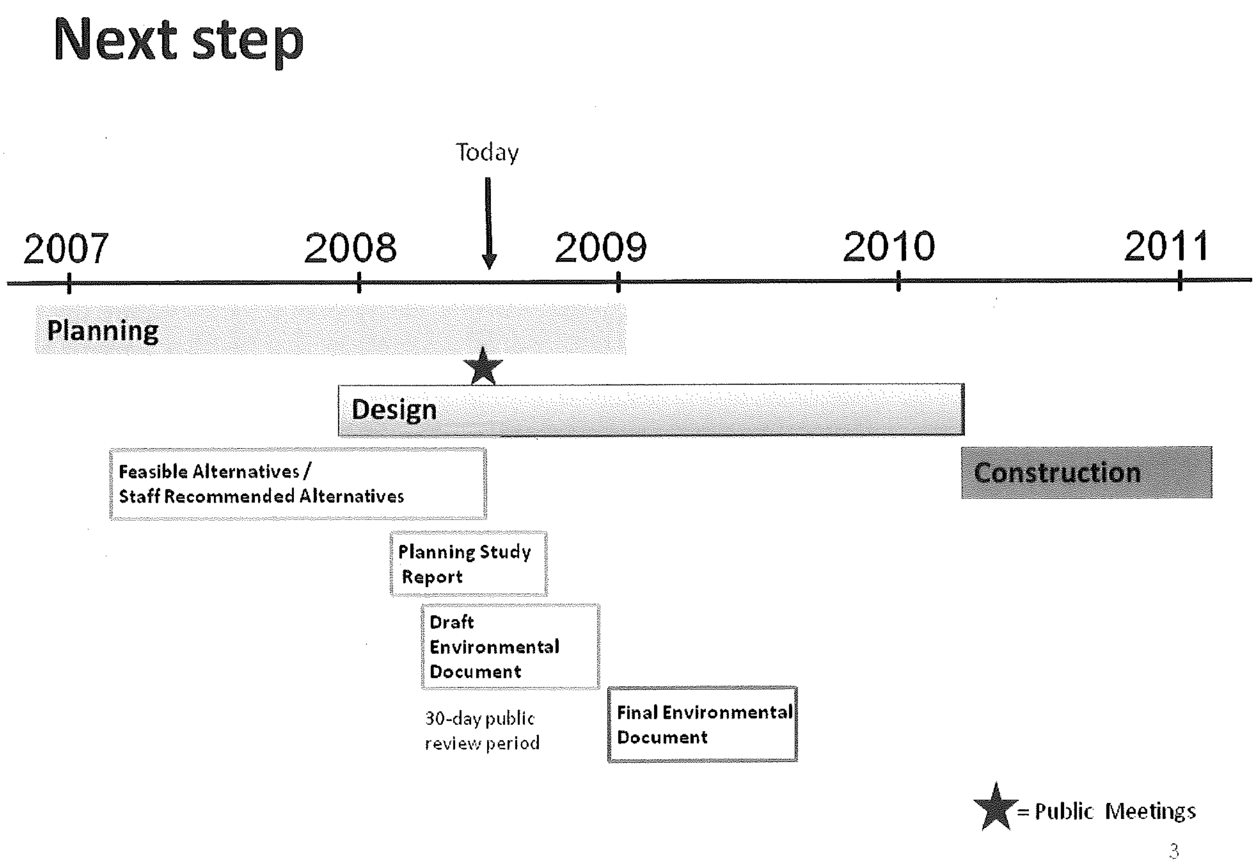

Next step
Today
2007
2008
2009
2010
2011
Planning
Design
Feasible Alternatives / Staff Recommended Alternatives
Planning Study Report
Draft Environmental Document
30-day public review period
Final Environmental Document
Construction
★ = Public Meetings
3

Figure 9-1: Project Schedule

Construction Permits Required

The District will need permits/agreements from the following agencies before constructing the recommended project.

- California Department of Fish and Game 1601 permit
- US Army Corps of Engineers
- City of Saratoga street opening or closing permit
- City of Saratoga tree removal permit
- Construction and maintenance agreement with UPRR
- USACE
- RWQCB

The District will need to enter into temporary construction easements agreements with the following:

City of Saratoga
Union Pacific Railroad
PG & E

Utility Impacts

Replacement of the Saratoga-Sunnyvale Road box culvert will impact the following utilities:

AT&T:
Nine 4" conduits along culvert upstream face

City of Saratoga:
Storm drain below southbound lanes of Saratoga-Sunnyvale Road

Cupertino Sanitary District:
Two 6" CIP siphon below southbound lanes of Saratoga-Sunnyvale Road

Pacific Gas and Electric:
One 4" diameter gas line

San Jose Water Company:
One 18" diameter water line

Replacement of the UPRR Bridge will impact the following utilities:

Pacific Gas and Electric:
Misc electrical tower conduits

Santa Clara Valley Water Company:
Possible impacts to Turn Out Vault, Remote Terminal Unit, Stage Housing

All of the above utilities will need to be relocated as a result of the project.

CHAPTER 10 – CONCLUSIONS AND RECOMMENDATIONS

A comprehensive study of the Calabazas Creek from Miller Avenue to Comer Drive and its 2 tributaries, the Rodeo and Regnart Creeks, was conducted. The project was supported by the Clean, Safe Creek and Natural Flood Protection program approved by the voters of Santa Clara County in 2000. Extensive community outreach was carried out to solicit flood information and discuss flood-protection alternatives. The findings and recommendations of the project are summarized below.

10.1 CONCLUSIONS

The project objectives included providing flood protection for flows up to the 1-percent flood, minimize maintenance cost, develop plans for creek restoration, and identify opportunities for environmental enhancement.

To protect against 1-percent flood, the project identified 2 locations where overbank flow would occur. They are at the Saratoga-Sunnyvale Road and the UPRR crossing in the City of Saratoga. At both locations, an undersized culvert under Saratoga-Sunnyvale Road and a small wooden bridge under UPRR would back up the flood water to cause overflow just upstream of the culvert and bridge entrances. Several alternatives were developed to contain the floodwater. At the Saratoga-Sunnyvale Road, enlarging the entrance section of the culvert and incorporating a natural swale as a detention pond was found to be the best alternative. At the UPRR crossing, replacing and enlarging the culvert was found to be the optimal alternative. The construction cost of the flood protection work was estimated to be $4.7 million.

To perform the work described above, temporary construction easements from the City of Saratoga and the UPRR are needed. No other rights of way are required.

To minimize maintenance cost, 14 sites were identified to have significant bank erosion problems. Plans were developed to protect the banks with either natural tree logs or rock riprap and planting of native trees or groundcover. A list of the erosion sites and protection measure is shown in Table 3-1. The construction cost of this erosion protection work was estimated at $250,000 dollars.

In addition to the staff recommended Project scope, 2 environmental enhancement opportunities were identified for Board consideration. One was to remove the Comer Dam and restore the channel to a stable slope with a series of small drops. This enhancement would eliminate the need to perform periodic sediment-removal from the Comer debris basin, remove a major concrete structure from a natural environment, and restore the creek channel. To perform the work at Comer, temporary construction easement is needed. No other rights of way are required. The other was to revegetate a 3,800-square-feet area of the bank downstream of Prospect Road to improve the riparian habitat. The total cost of the enhancement work would be $1.1 million. No right of way is required for the enhancement work except for two small TCE's upstream of Comer Drive.

10.2 STAFF RECOMMENDATIONS

- **Staff-Recommended Project**

  To meet objectives of the Clean, Safe Creek Program, staff recommends that the Board consider undertaking the following works of improvement:

  - Swale Detention and Culvert Modification at Saratoga-Sunnyvale Road
  - Culvert Replacement at UPRR Crossing
  - Erosion Protection at 14 sites

- **Staff-Identified Enhancement Opportunities**

  Staff has identified the following 2 enhancement opportunities for the Board consideration:

  - Comer Dam Modification
  - Revegetation Downstream of Prospect Road

Plates

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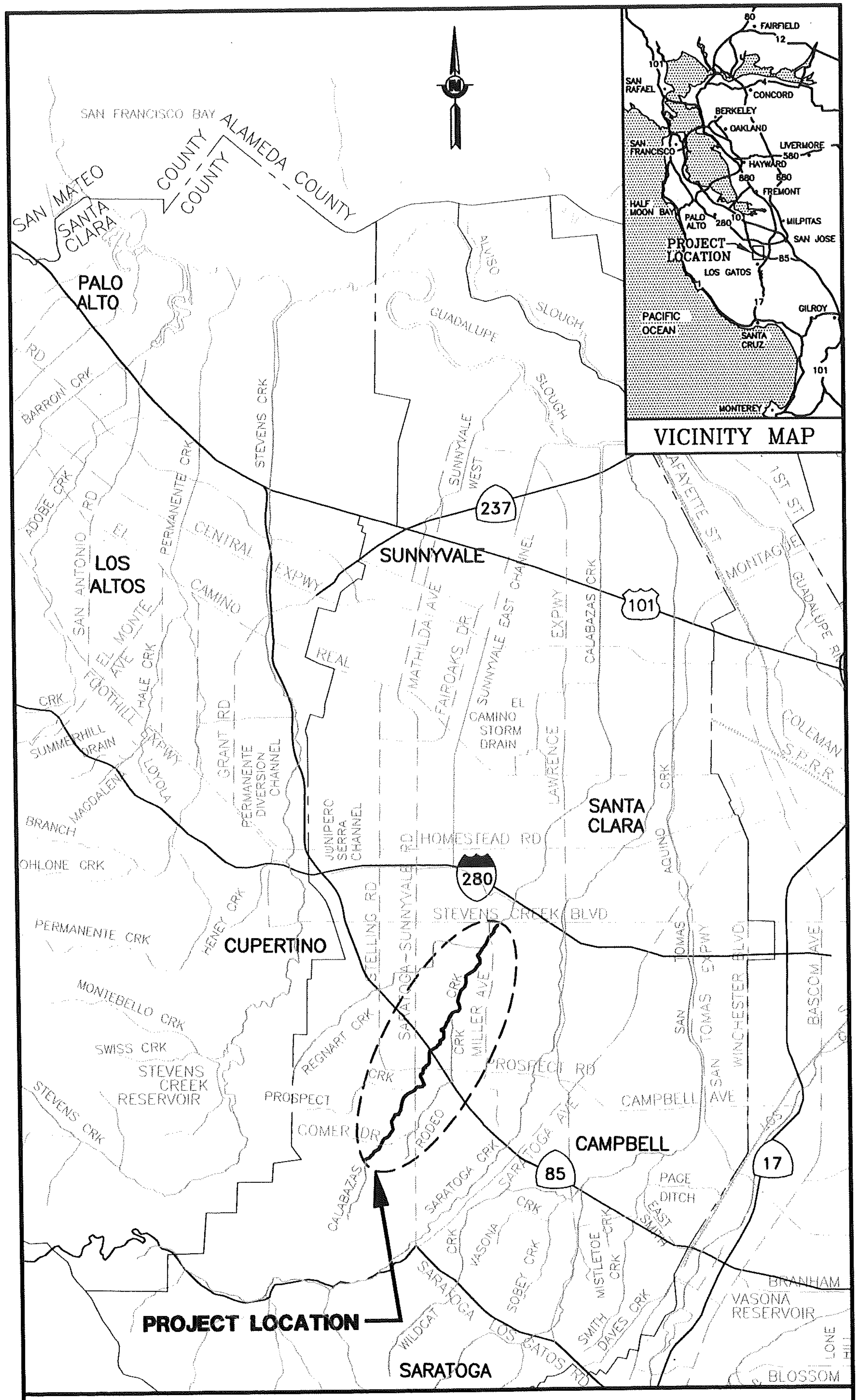

LOCATION MAP
SCALE: 1"=5,000'

MAP AND GENERAL PLAN
FOR
# CALABAZAS CREEK PLANNING STUDY
FROM
MILLER AVENUE TO WARDELL ROAD

Santa Clara Valley Water District SM

APPROVED BY:

Saeid Hosseini 8/21/08
SAEID HOSSEINI, P.E. DATE
SENIOR PROJECT MANAGER – CAPITAL PROGRAM SERVICES DIVISION
SANTA CLARA VALLEY WATER DISTRICT

SAEID S. HOSSEINI
No. 50920
Exp. 9/30/09
CIVIL

Katherine Oven 8/21/08
KATHERINE OVEN, P.E. DATE
ASSISTANT OPERATING OFFICER – CAPITAL PROGRAM SERVICES DIVISION
SANTA CLARA VALLEY WATER DISTRICT

PLANNING STUDY REPORT
08-04-08

PROJECT NUMBER	26104001
SHEET CODE:	G-1
PAGE NUMBER:	1 OF 30

DOCUMENT NUMBER:

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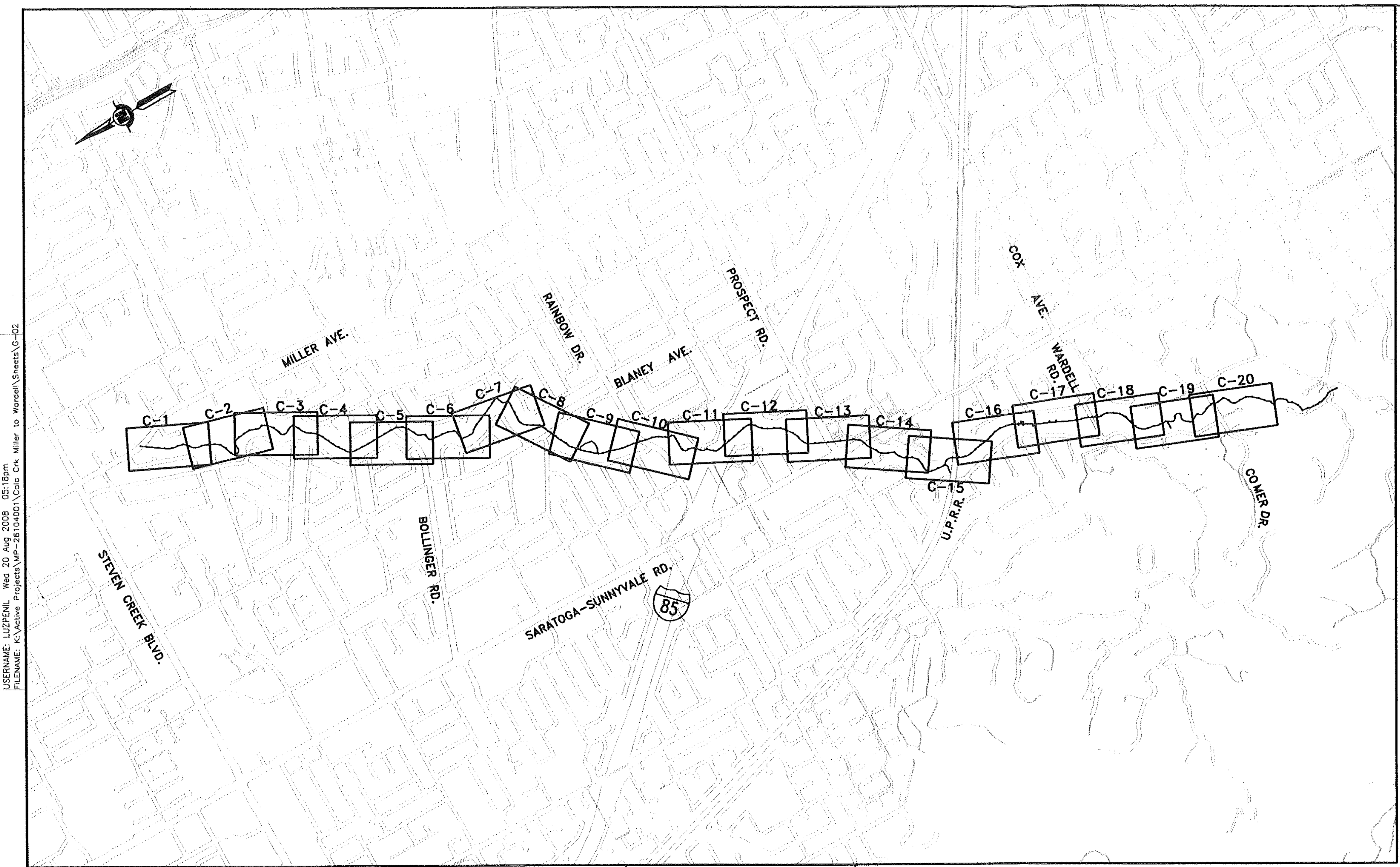

INDEX MAP
SCALE: 1"=1000'

DRAWING INDEX

SHEET NO.	DESCRIPTION	PAGE NO.
	GENERAL	
G-1	MAP AND TITLE PAGE	1 OF 30
G-2	INDEX MAP, DRAWING LIST AND GENERAL NOTES	2 OF 30
G-3	ABBREVIATIONS AND LEGEND	3 OF 30
	CIVIL	
C-1	PLAN AND PROFILE, STA 403+39.5 TO STA 410+00	4 OF 30
C-2	PLAN AND PROFILE, STA 410+00 TO STA 420+00	5 OF 30
C-3	PLAN AND PROFILE, STA 420+00 TO STA 430+00	6 OF 30
C-4	PLAN AND PROFILE, STA 430+00 TO STA 440+00	7 OF 30
C-5	PLAN AND PROFILE, STA 440+00 TO STA 450+00	8 OF 30
C-6	PLAN AND PROFILE, STA 450+00 TO STA 460+00	9 OF 30
C-7	PLAN AND PROFILE, STA 460+00 TO STA 470+00	10 OF 30
C-8	PLAN AND PROFILE, STA 470+00 TO STA 480+00	11 OF 30
C-9	PLAN AND PROFILE, STA 480+00 TO STA 490+00	12 OF 30
C-10	PLAN AND PROFILE, STA 490+00 TO STA 500+00	13 OF 30
C-11	PLAN AND PROFILE, STA 500+00 TO STA 510+00	14 OF 30
C-12	PLAN AND PROFILE, STA 510+00 TO STA 520+00	15 OF 30
C-13	PLAN AND PROFILE, STA 520+00 TO STA 530+00	16 OF 30
C-14	PLAN AND PROFILE, STA 530+00 TO STA 540+00	17 OF 30
C-15	PLAN AND PROFILE, STA 540+00 TO STA 550+00	18 OF 30
C-16	PLAN AND PROFILE, STA 550+00 TO STA 560+00	19 OF 30
C-17	PLAN AND PROFILE, STA 560+00 TO STA 570+00	20 OF 30
C-18	PLAN AND PROFILE, STA 570+00 TO STA 580+00	21 OF 30
C-19	PLAN AND PROFILE, STA 580+00 TO STA 590+00	22 OF 30
C-20	PLAN AND PROFILE, STA 590+00 TO STA 599+00	23 OF 30
	TYPICAL SECTIONS	
C-21	TYPICAL CROSS SECTIONS	24 OF 30
C-22	TYPICAL CROSS SECTIONS	25 OF 30
C-23	TYPICAL CROSS SECTIONS	26 OF 30
C-24	TYPICAL CROSS SECTIONS	27 OF 30
C-25	TYPICAL CROSS SECTIONS	28 OF 30
C-26	TYPICAL CROSS SECTIONS	29 OF 30
C-27	ROCK WEIR DETAILS	30 OF 30

GENERAL NOTES

1. DESIGN DISCHARGES ARE:

LOCATION	1% FLOWRATE (cfs)	10% FLOWRATE (cfs)
U/S MILLER – D/S REGNANT CREEK	2650	1650
U/S REGNANT CREEK – D/S BOLLINGER	2100	1300
D/S BOLLINGER – D/S RODEO CREEK	2000	1200
U/S RODEO CREEK – D/S RAINBOW OUTFALL	1600	980
D/S RAINBOW OUTFALL – U FRAME U/S SR85	1540	920
U FRAME U/S SR85 – UNDER TUNNEL	1470	860
UNDER TUNNEL – D/S PROSPECT CREEK	1400	800
U/S PROSPECT CREEK – U/S COMER	1100	650

2. MANNING ROUGHNESS COEFFICIENT (n):

A. CONCRETE	0.015
B. ROCK RIPRAP	0.035
C. ROCK CUT	0.025
D. SACKED CONCRETE	0.028

FOR A MORE DETAILED CALCULATION OF MANNING ROUGHNESS COEFICIENT SEE "N" VALUE CALCULATION REPORT ESTABLISHED SEPTEMBER, 2005

3. BASIS OF ELEVATION: NAVD 1988

4. BASIS OF BEARING: HPGN-D SAN ANTONIO & VASONA

5. ALL TYPICAL SECTIONS ARE LOOKING UPSTREAM

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
	PLANNING STUDY REPORT 08-04-08			

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 40727
Exp. 12/31/09
CIVIL

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

INDEX MAP, DRAWING LIST
AND GENERAL NOTES

SCALE: NOT TO SCALE

VERIFY SCALES
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PROJECT NUMBER: 26104001

SHEET CODE: G-2

PAGE NUMBER: 2 OF 30

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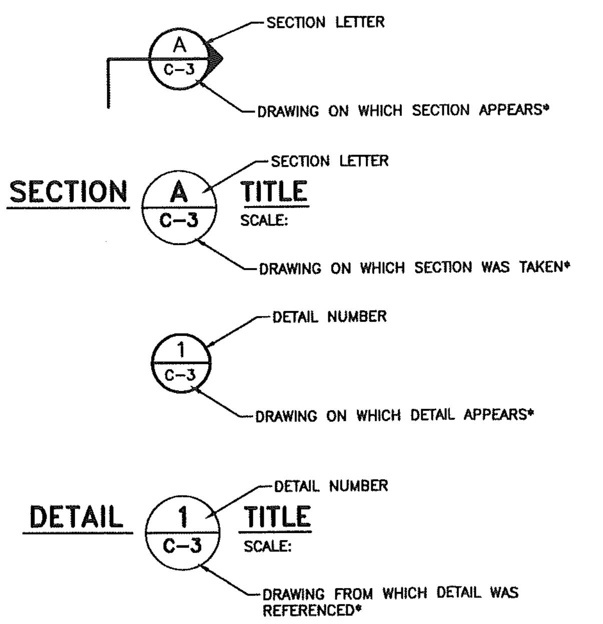
ABBREVIATIONS

ABM	Air Blown Mortar
ABS	Acrylonitrile-Butadience-Styrene
AC	Asphalt Concrete
ACP	Asphalt Concrete Pipe
AISI	American Iron & Steel Institute
ALIGN	Alignment
AMP	Amperes
ANSI	American National Standards Institute
APPROX	Approximate
ARV	Air Release Valve
ASA	American Standard Association
ASTM	American Society for Testing Materials
AWG	American Wire Gage
AWWA	American Water Works Association
BC	Begin Curve
BM	Bench Mark
BT	Backhoe Trench
BW	Both Ways
℄	Centerline
CB	Catch Basin (Inlet)
CCCL	Cement Mortar Coated & Lined Steel Pipe
CCEM	Cement Conduit
CCTL	Corrosion Control Test Leads
CCP	Concrete Cylinder Pipe
CFM	Cubic Feet Per Minute
CI	Cast Iron
CIP	Cast Iron Pipe
CL	Clearance
CLF	Chain Link Fence
CLR	Clear
CMC	Cement Mortar Coat
CML	Cement Mortar Line
CMP	Corrugated Metal Pipe
CO	Clean Out
CONC	Concrete
CONT	Continuous
CP	Cement Pipe
CPC	Plastic Conduit
CSP	Corrugated Steel Pipe
CTP	Cable Television Pole
CTV	Cable TV
CU FT	Cubic Feet
CYL	Cylinder
CIPP	Cast-In-Place Pipe
DH	Drill Holes
DIA	Diameter
DICL	Ductile Iron Cement Lined
DIP	Ductile Iron Pipe
DP	Drain Pipe
DPDT	Double Pole Double Throw
D/S	Downstream
DWR	Department of Water Resources
EC	End Curve
ELEC	Electrical
ELEV	Elevation
EP	Edge of Pavement
EXIST	Existing
FF	Full Force
FH	Fire Hydrant
FKCL	Fiberglass-Kraft Wrap Cement Lined
FLG	Flange
FP	Feeder Pressure
FT	Feet
GA	Gage
GALV	Galvanized
GFI	Ground Fault Interrupter
HC	House Connection (sanitary)
HMW/PE	High Molecular Weight Polyethylene
HORIZ	Horizontal
HP	Horsepower
ID	Inside Diameter
IF	Inside Face
IL	Inductive Loop
IN	Inch
INSUL	Insulation
INV	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
JT	Joint Trench
KV	Kilo Volt
LB	Conduit Fitting Elbow
LG	Long
LLV	Long Leg Vertical
LT	Left
MAINT	Maintenance
MAX	Maximum
MCD	Multiple Conduits
MCI	MCI Telecommunication Corp.
MH	Manhole
MIN	Minimum
MON	Monument
MW	Monitoring Well
N	Nitrogen
N/A	Not Applicable
NE	Northeast
NEMA	National Electrical Manufacturers Association
NO	Number
NTS	Not To Scale
NW	Northwest
OC	On Center
OD	Outside Diameter
OF	Outside Face
OH	Overhead
OW	Observation Well
℘	Property Line
PCC	Portland Cement Concrete
PCCP	Prestressed Concrete Cylinder Pipe
PE	Plain End
PG&E	Pacific Gas and Electric
PI	Point of Intersection
PK	Parker-Kalon Survey Nail
PL	Plastic Line
POT	Point on Tangent
PP	Power Pole
PRC	Point of Reverse Curve
PROP	Proposed
PSI	Pound Per Square Inch
PT&T	Pacific Telephone and Telegraph
PUE	Public Utility Easement
PV	Precast Vault
PVC	Polyvinyl Chloride
PVMT	Pavement
PW	Pumping Well
R	Radius
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RE	Reference Electrode
REBAR	Reinforcing Bar
REINF	Reinforced
REQ'D	Required
RR	Railroad
RR/USE	Underground Service Entrance
RT	Right
RTU	Remote Terminal Unit
R/W	Right of Way
S	Slope
SCHED	Schedule
SCSP	Sacked Concrete Slope Protection
SCVWD	Santa Clara Valley Water District
SD	Storm Drain
SE	Southeast
SECT	Section
SHT	Sheet
SJMW	San Jose Municipal Water
SJWC	San Jose Water Company
SOMCL	Standard Oil Mastic Cement Lined
SPECS	Specifications
SPRR	Southern Pacific Railroad
SQ	Square
SR	State Route
SS	Sanitary Sewer
SSTL	Stainless Steel
ST	Street
STA	Station
STD	Standard
STL	Steel
STRD	Stranded
SW	Southwest
SYM	Symmetrical
T	Telephone
t	Thickness of Plate or Dimension of Weld
TBM	Temporary Bench Mark
TC	Telemetry Cable
TCA	Temporary Construction Area
TCE	Temporary Construction Easement
TCS	Telemetry Cable Splice
TEL	Telephone
THW	Thermal Plastic Moisture and Heat Resistant
THWN	Thermal Plastic With Nylon Coating Moisture and Heat Resistant
TOB	Top of Bank
TOC	Toe of Channel
TP	Test Pit Location
TR	Tape Wrapped
TS	Traffic Signal
TYP	Typical
UG	Underground
UPRR	Union Pacific Railroad
U/S	Upstream
USGS	United States Geological Survey
V	Voltage
VAC	Voltage Alternating Current
VCD	Vacant Conduit
VCP	Vitrified Clay Pipe
VERT	Vertical
W	Water
WD	Wood (Wooden)
WP	Work Point
WSL	Water Surface Level
WSP	Welded Steel Pipe
WSCL	Wrapped Steel Cement Lined
WV	Water Valve
WWF	Welded Wire Fabric
W/	With
&	And
@	At
℄	Centerline
Ø	Diameter
℘	Property Line

DETAIL AND SECTION DESIGNATION

* IF SECTION OR DETAIL APPEARS ON THE SAME DRAWING AS THE CALL-OUT THE DRAWING REFERENCE IS REPLACED WITH A DASH (-)


A
C-3
SECTION LETTER
DRAWING ON WHICH SECTION APPEARS*
SECTION
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C-3
SECTION LETTER
TITLE
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DRAWING ON WHICH SECTION WAS TAKEN*
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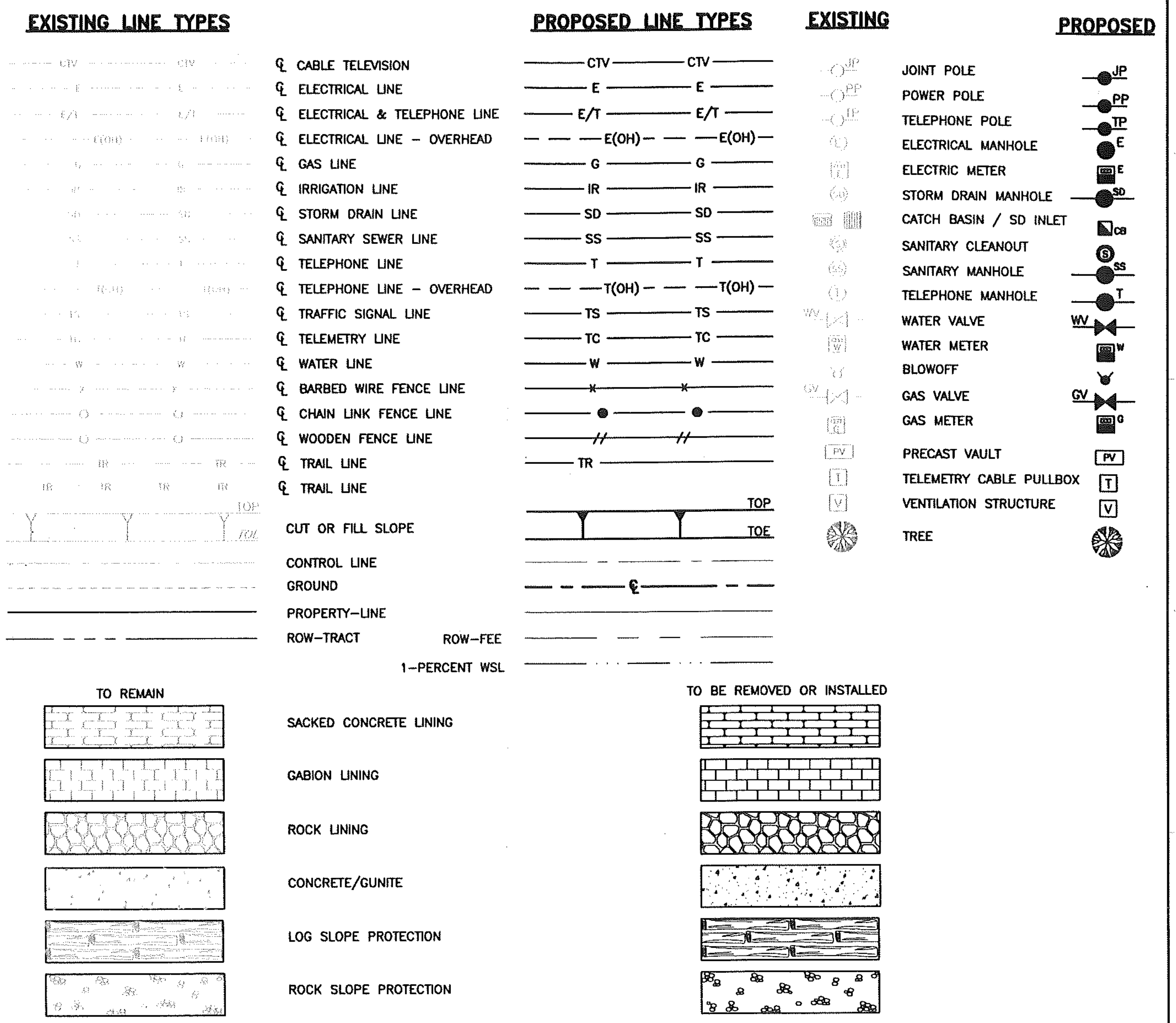
C-3
DETAIL NUMBER
DRAWING ON WHICH DETAIL APPEARS*
DETAIL
1
C-3
DETAIL NUMBER
TITLE
SCALE:
DRAWING FROM WHICH DETAIL WAS REFERENCED*

LINE TYPE LEGEND

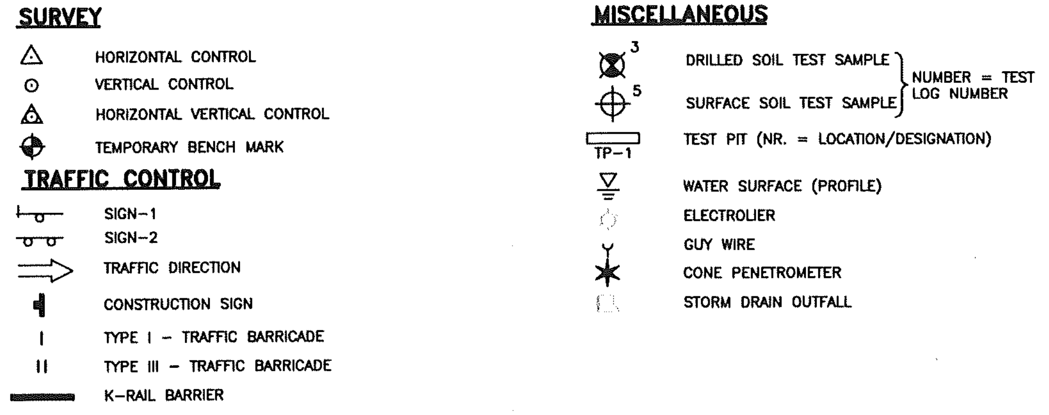


EXISTING LINE TYPES		PROPOSED LINE TYPES
CTV	℄ CABLE TELEVISION	CTV
E	℄ ELECTRICAL LINE	E
E/T	℄ ELECTRICAL & TELEPHONE LINE	E/T
E(OH)	℄ ELECTRICAL LINE - OVERHEAD	E(OH)
G	℄ GAS LINE	G
IR	℄ IRRIGATION LINE	IR
SD	℄ STORM DRAIN LINE	SD
SS	℄ SANITARY SEWER LINE	SS
T	℄ TELEPHONE LINE	T
T(OH)	℄ TELEPHONE LINE - OVERHEAD	T(OH)
TS	℄ TRAFFIC SIGNAL LINE	TS
TC	℄ TELEMETRY LINE	TC
W	℄ WATER LINE	W
x	℄ BARBED WIRE FENCE LINE	x
O	℄ CHAIN LINK FENCE LINE	●
O	℄ WOODEN FENCE LINE	//
TR	℄ TRAIL LINE	TR
TR	℄ TRAIL LINE	
TOP TOE	CUT OR FILL SLOPE	TOP TOE
	CONTROL LINE	
	GROUND	℄
	PROPERTY-LINE	
	ROW-TRACT	
	ROW-FEE	
	1-PERCENT WSL	

TO REMAIN		TO BE REMOVED OR INSTALLED
	SACKED CONCRETE LINING	
	GABION LINING	
	ROCK LINING	
	CONCRETE/GUNITE	
	LOG SLOPE PROTECTION	
	ROCK SLOPE PROTECTION	

EXISTING		PROPOSED
JP	JOINT POLE	JP
PP	POWER POLE	PP
TP	TELEPHONE POLE	TP
E	ELECTRICAL MANHOLE	E
E	ELECTRIC METER	E
SD	STORM DRAIN MANHOLE	SD
	CATCH BASIN / SD INLET	CB
S	SANITARY CLEANOUT	S
SS	SANITARY MANHOLE	SS
T	TELEPHONE MANHOLE	T
WV	WATER VALVE	WV
W	WATER METER	W
	BLOWOFF	
GV	GAS VALVE	GV
G	GAS METER	G
PV	PRECAST VAULT	PV
T	TELEMETRY CABLE PULLBOX	T
V	VENTILATION STRUCTURE	V
	TREE	

SYMBOLS LEGEND



SURVEY

- HORIZONTAL CONTROL
- VERTICAL CONTROL
- HORIZONTAL VERTICAL CONTROL
- TEMPORARY BENCH MARK

TRAFFIC CONTROL

- SIGN-1
- SIGN-2
- TRAFFIC DIRECTION
- CONSTRUCTION SIGN
- TYPE I - TRAFFIC BARRICADE
- TYPE III - TRAFFIC BARRICADE
- K-RAIL BARRIER

MISCELLANEOUS

- 3 DRILLED SOIL TEST SAMPLE
- 5 SURFACE SOIL TEST SAMPLE

NUMBER = TEST LOG NUMBER

- TP-1 TEST PIT (NR. = LOCATION/DESIGNATION)
- WATER SURFACE (PROFILE)
- ELECTROLIER
- GUY WIRE
- CONE PENETROMETER
- STORM DRAIN OUTFALL

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	PLANNING STUDY REPORT 08-04-08			

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION
LEROY R. WEESE
No. 50727
Exp. 12/31/09
CIVIL
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD
ABBREVIATIONS AND LEGEND

SCALE
NOT TO SCALE
VERIFY SCALES
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26104001
SHEET CODE:
G-3
PAGE NUMBER:
3 OF 30

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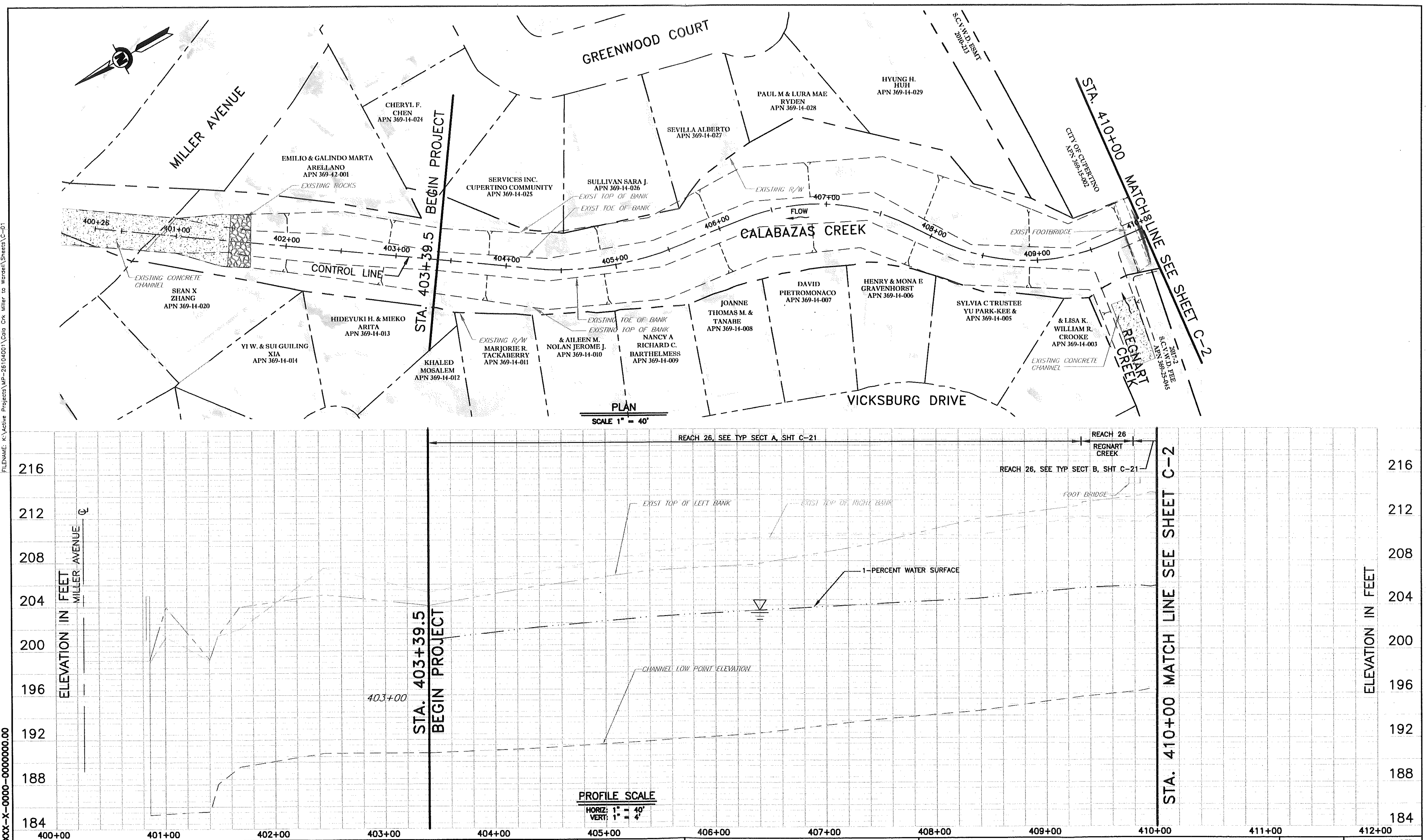
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MILLER AVENUE
S.C.V.W.D. ESMT 2010-213
HYUNG H. HUH APN 369-14-029
PAUL M & LURA MAE RYDEN APN 369-14-028
SEVILLA ALBERTO APN 369-14-027
CHERYL F. CHEN APN 369-14-024
EMILIO & GALINDO MARTA ARELLANO APN 369-42-001
EXISTING ROCKS
SERVICES INC. CUPERTINO COMMUNITY APN 369-14-025
SULLIVAN SARA J. APN 369-14-026
EXIST TOP OF BANK
EXIST TOE OF BANK
EXISTING R/W
CITY OF CUPERTINO APN 369-15-002
STA. 410+00 MATCHLINE SEE SHEET C-2
STA. 403+39.5 BEGIN PROJECT
400+26
401+00
402+00
403+00
404+00
405+00
406+00
407+00
408+00
409+00
410+08
FLOW
CALABAZAS CREEK
CONTROL LINE
EXIST FOOTBRIDGE
EXISTING CONCRETE CHANNEL
SEAN X ZHANG APN 369-14-020
HIDEYUKI H. & MIEKO ARITA APN 369-14-013
YI W. & SUI GUILING XIA APN 369-14-014
KHALED MOSALEM APN 369-14-012
EXISTING R/W
MARJORIE R. TACKABERRY APN 369-14-011
& AILEEN M. NOLAN JEROME J. APN 369-14-010
EXISTING TOE OF BANK
EXISTING TOP OF BANK
NANCY A RICHARD C. BARTHELMESS APN 369-14-009
JOANNE THOMAS M. & TANABE APN 369-14-008
DAVID PIETROMONACO APN 369-14-007
HENRY & MONA E GRAVENHORST APN 369-14-006
SYLVIA C TRUSTEE YU PARK-KEE & APN 369-14-005
& LISA K. WILLIAM R. CROOKE APN 369-14-003
EXISTING CONCRETE CHANNEL
REGNART CREEK
S.C.V.W.D. FEE 2017-2 APN 369-25-045
VICKSBURG DRIVE
PLAN
SCALE 1" = 40'
REACH 26, SEE TYP SECT A, SHT C-21
REACH 26
REGNART CREEK
REACH 26, SEE TYP SECT B, SHT C-21
FOOT BRIDGE
EXIST TOP OF LEFT BANK
EXIST TOP OF RIGHT BANK
1-PERCENT WATER SURFACE
CHANNEL LOW POINT ELEVATION
MILLER AVENUE ℄
ELEVATION IN FEET
STA. 403+39.5 BEGIN PROJECT
STA. 410+00 MATCH LINE SEE SHEET C-2
403+00
PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'
216
212
208
204
200
196
192
188
184
400+00
401+00
402+00
403+00
404+00
405+00
406+00
407+00
408+00
409+00
410+00
411+00
412+00

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2650 CFS, 10% FLOWRATE 1650 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 59727
Exp. 12/31/09
CIVIL

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 403+39.5 TO STA 410+00

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PROJECT NUMBER
26104001

SHEET CODE:
C-1

PAGE NUMBER:
4 OF 30

DOCUMENT NUMBER: XXXX-X-0000-000000.00

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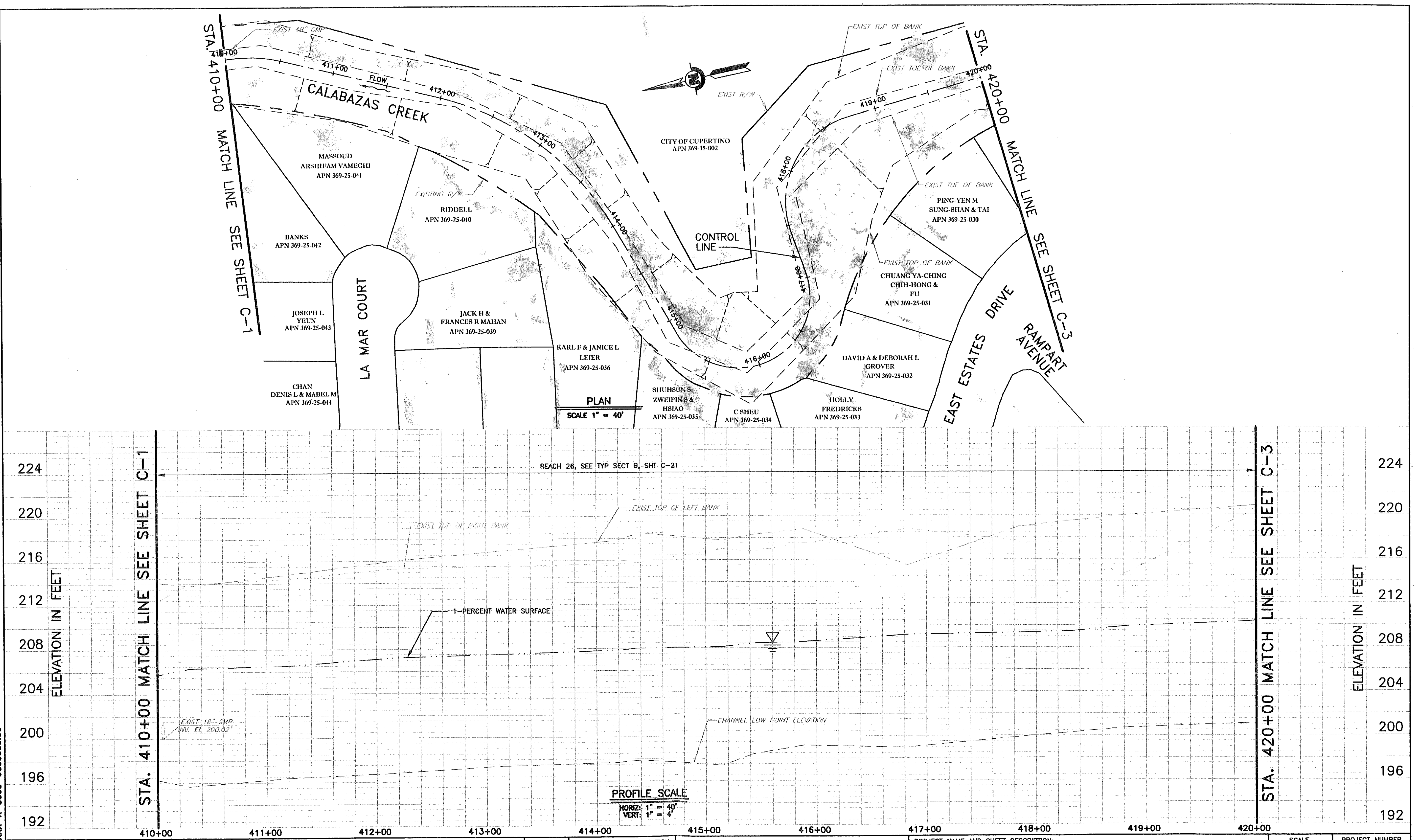

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REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2100 CFS, 10% FLOWRATE 1300 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE No. 56727 CIVIL

L. A. Weese

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 410+00 TO STA 420+00

SCALE: AS SHOWN

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PROJECT NUMBER: 26104001

SHEET CODE: C-2

PAGE NUMBER: 5 OF 30

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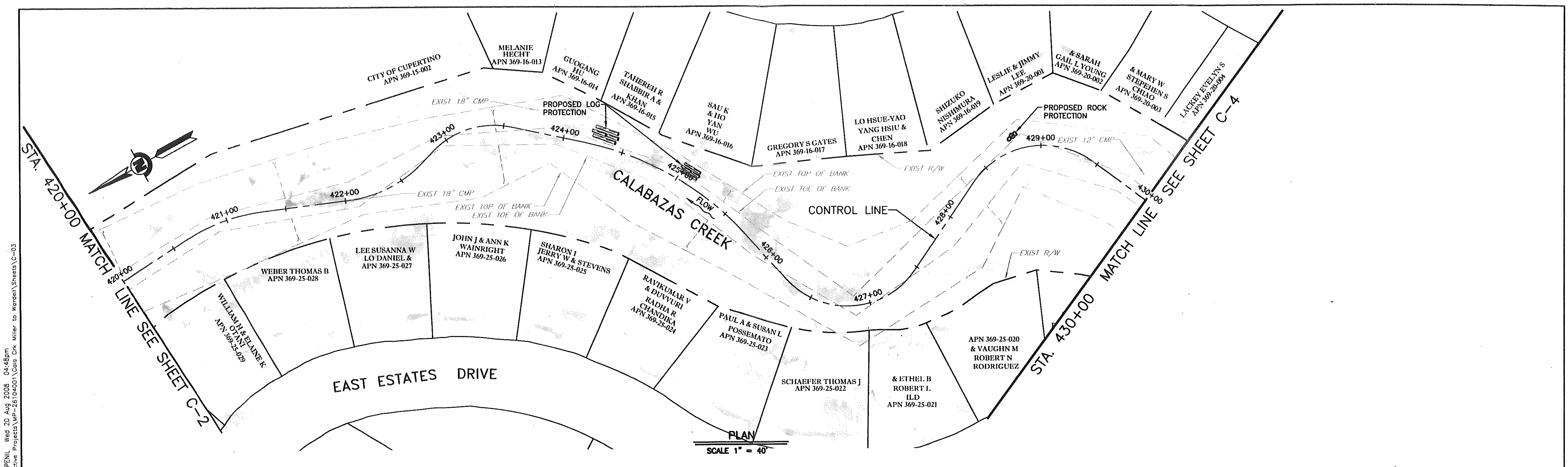
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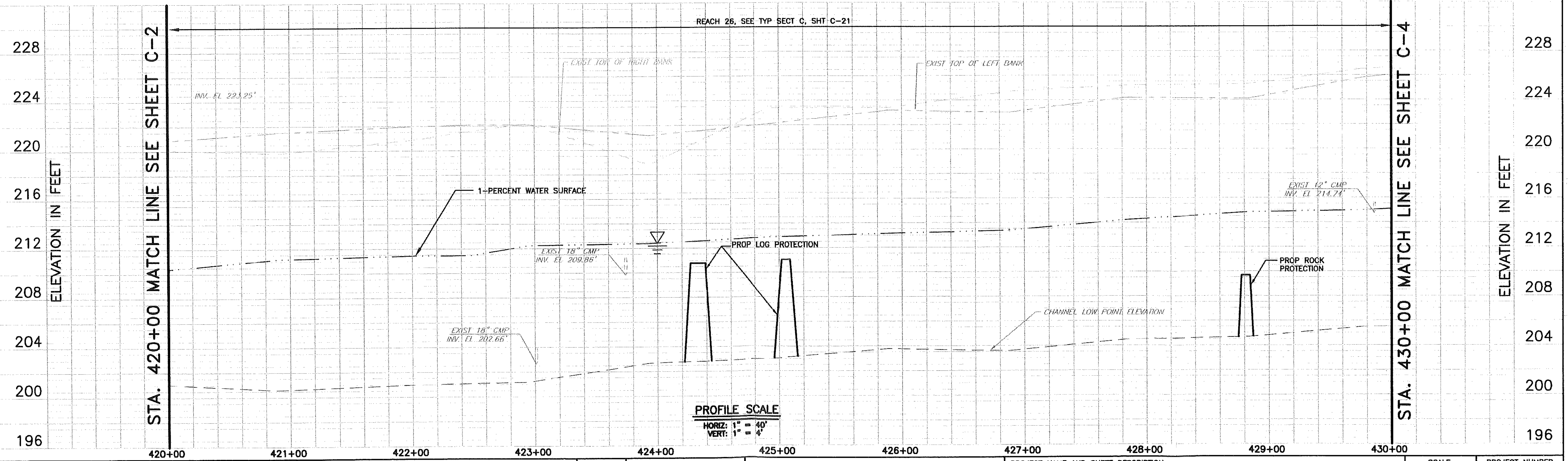
MELANIE HECHT APN 369-16-013
GUOGANG HU APN 369-16-014
TAHEREH R SHABBIR A & KHAN APN 369-16-015
SAU K & HO YAN WU APN 369-16-016
GREGORY S GATES APN 369-16-017
LO HSUE-YAO YANG HSIU & CHEN APN 369-16-018
SHIZUKO NISHIMURA APN 369-16-019
LESLIE & JIMMY LEE APN 369-20-001
& SARAH GAIL L YOUNG APN 369-20-002
& MARY W STEPEHEN S CHIAO APN 369-20-003
LACKEY EVELYN S APN 369-20-004
EXIST 18" CMP
PROPOSED LOG PROTECTION
PROPOSED ROCK PROTECTION
EXIST 12" CMP
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST R/W
CONTROL LINE
CALABAZAS CREEK
FLOW
STA. 420+00 MATCH LINE SEE SHEET C-2
STA. 430+00 MATCH LINE SEE SHEET C-4
420+00
421+00
422+00
423+00
424+00
425+00
426+00
427+00
428+00
429+00
430+00
WILLIAM H & ELAINE K OTANI APN 369-25-029
WEBER THOMAS B APN 369-25-028
LEE SUSANNA W LO DANIEL & APN 369-25-027
JOHN J & ANN K WAINRIGHT APN 369-25-026
SHARON I JERRY W & STEVENS APN 369-25-025
RAVIKUMAR V & DUVVURI RADHA R CHANDIKA APN 369-25-024
PAUL A & SUSAN L POSSEMATO APN 369-25-023
SCHAEFER THOMAS J APN 369-25-022
& ETHEL B ROBERT L ILD APN 369-25-021
APN 369-25-020 & VAUGHN M ROBERT N RODRIGUEZ
EAST ESTATES DRIVE

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2100 CFS, 10% FLOWRATE 1300 CFS.

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
R. AGREDA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 50731
Exp. 12/31/09
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 420+00 TO STA 430+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-3

PAGE NUMBER:
6 OF 30

DOCUMENT NUMBER: XXXX-X-0000-000000.00

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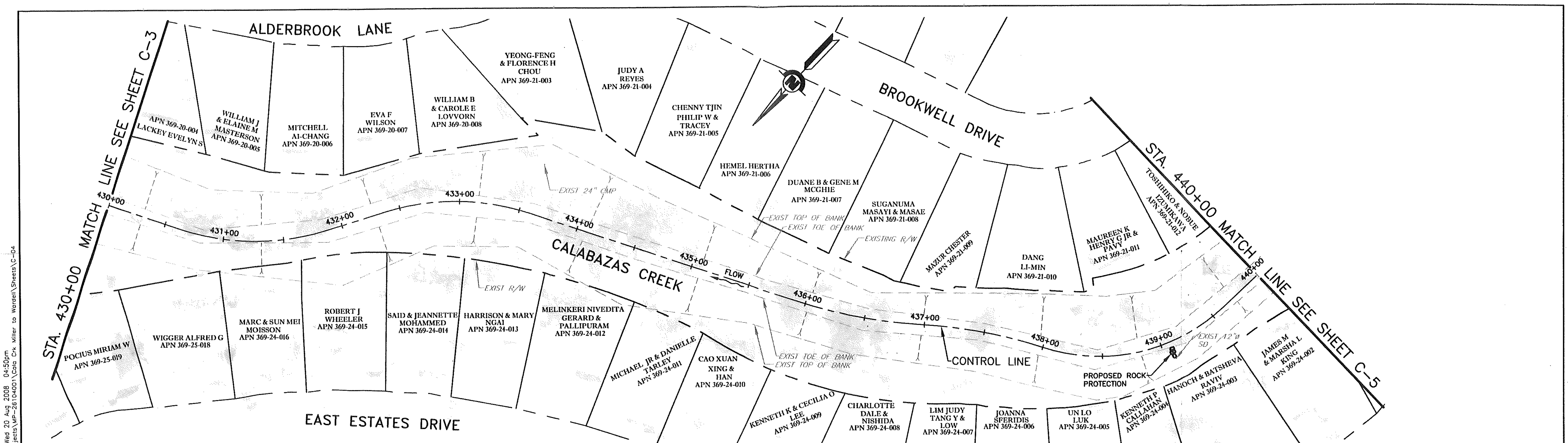
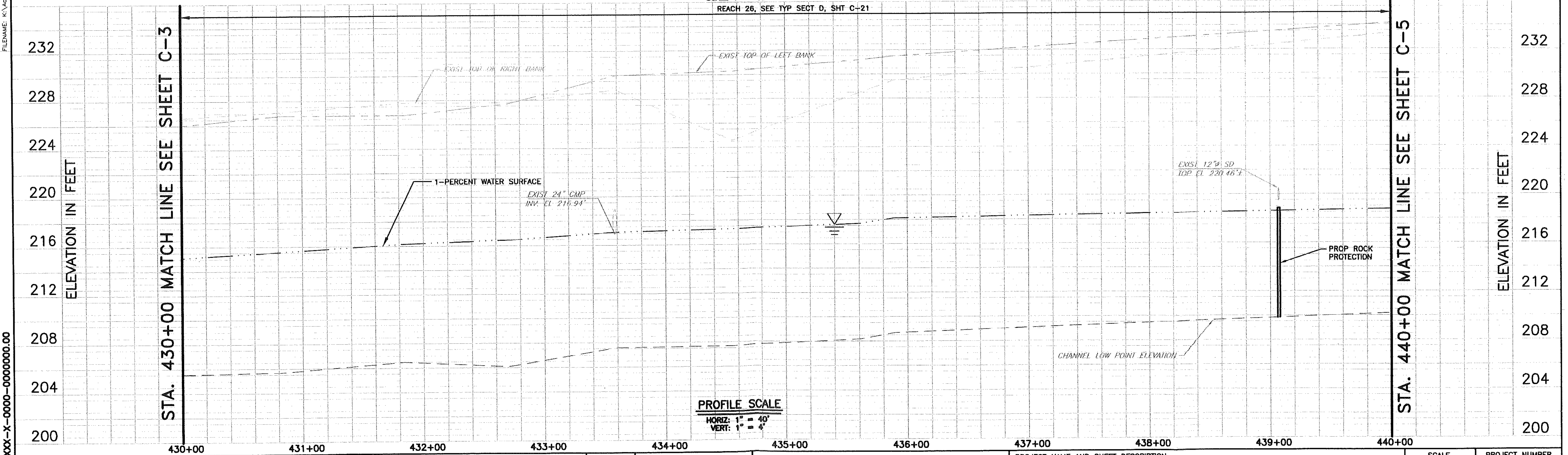

ALDERBROOK LANE
BROOKWELL DRIVE
EAST ESTATES DRIVE
CALABAZAS CREEK
STA. 430+00 MATCH LINE SEE SHEET C-3
STA. 440+00 MATCH LINE SEE SHEET C-5
430+00
431+00
432+00
433+00
434+00
435+00
436+00
437+00
438+00
439+00
440+00
FLOW
CONTROL LINE
EXIST 24" CMP
EXIST TOP OF BANK
EXIST TOE OF BANK
EXISTING R/W
EXIST R/W
EXIST 12"Ø SD
PROPOSED ROCK PROTECTION
APN 369-20-004 LACKEY EVELYN S
WILLIAM J & ELAINE M MASTERSON APN 369-20-005
MITCHELL AI-CHANG APN 369-20-006
EVA F WILSON APN 369-20-007
WILLIAM B & CAROLE E LOVVORN APN 369-20-008
YEONG-FENG & FLORENCE H CHOU APN 369-21-003
JUDY A REYES APN 369-21-004
CHENNY TJIN PHILIP W & TRACEY APN 369-21-005
HEMEL HERTHA APN 369-21-006
DUANE B & GENE M MCGHIE APN 369-21-007
SUGANUMA MASAYI & MASAE APN 369-21-008
MAZUR CHESTER APN 369-21-009
DANG LI-MIN APN 369-21-010
MAUREEN K HENRY G JR & PAVY APN 369-21-011
TOSHIHIKO & NOBUE IZUMIKAWA APN 369-21-012
POCIUS MIRIAM W APN 369-25-019
WIGGER ALFRED G APN 369-25-018
MARC & SUN MEI MOISSON APN 369-24-016
ROBERT J WHEELER APN 369-24-015
SAID & JEANNETTE MOHAMMED APN 369-24-014
HARRISON & MARY NGAI APN 369-24-013
MELINKERI NIVEDITA GERARD & PALLIPURAM APN 369-24-012
MICHAEL JR & DANIELLE TARLEY APN 369-24-011
CAO XUAN XING & HAN APN 369-24-010
KENNETH K & CECILIA O LEE APN 369-24-009
CHARLOTTE DALE & NISHIDA APN 369-24-008
LIM JUDY TANG Y & LOW APN 369-24-007
JOANNA SFERIDIS APN 369-24-006
UN LO LUK APN 369-24-005
KENNETH P CALLAHAN APN 369-24-004
HANOCH & BATSHEVA RAVIV APN 369-24-003
JAMES M & MARSHA L KING APN 369-24-002

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2100 CFS, 10% FLOWRATE 1300 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
Exp. 12/31/09
PROJECT ENGINEER DATE

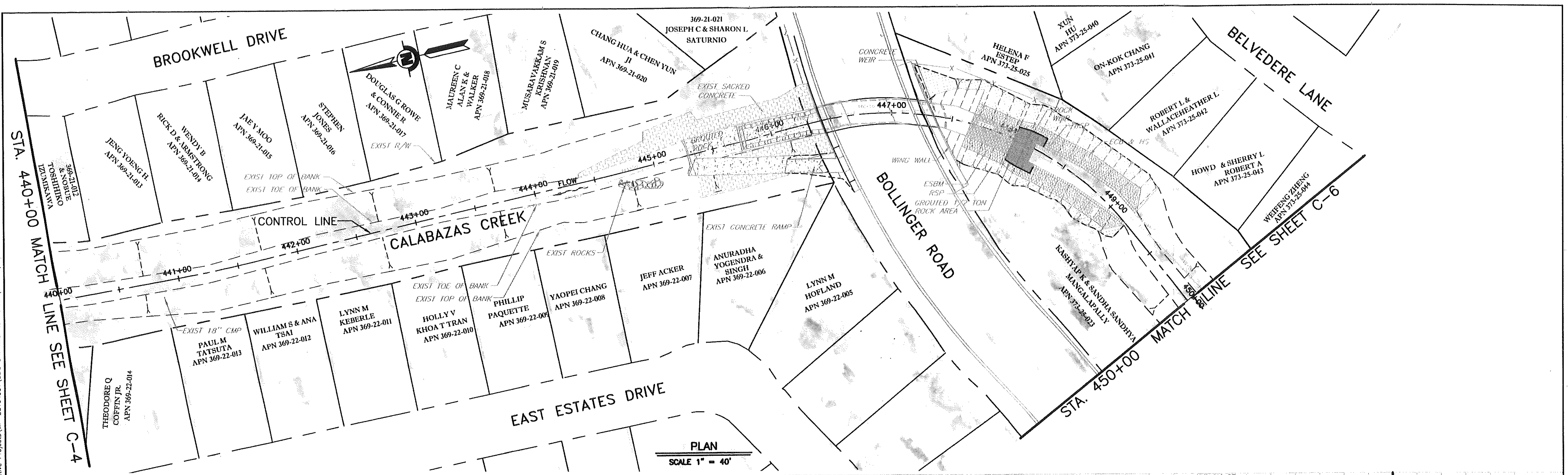
Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

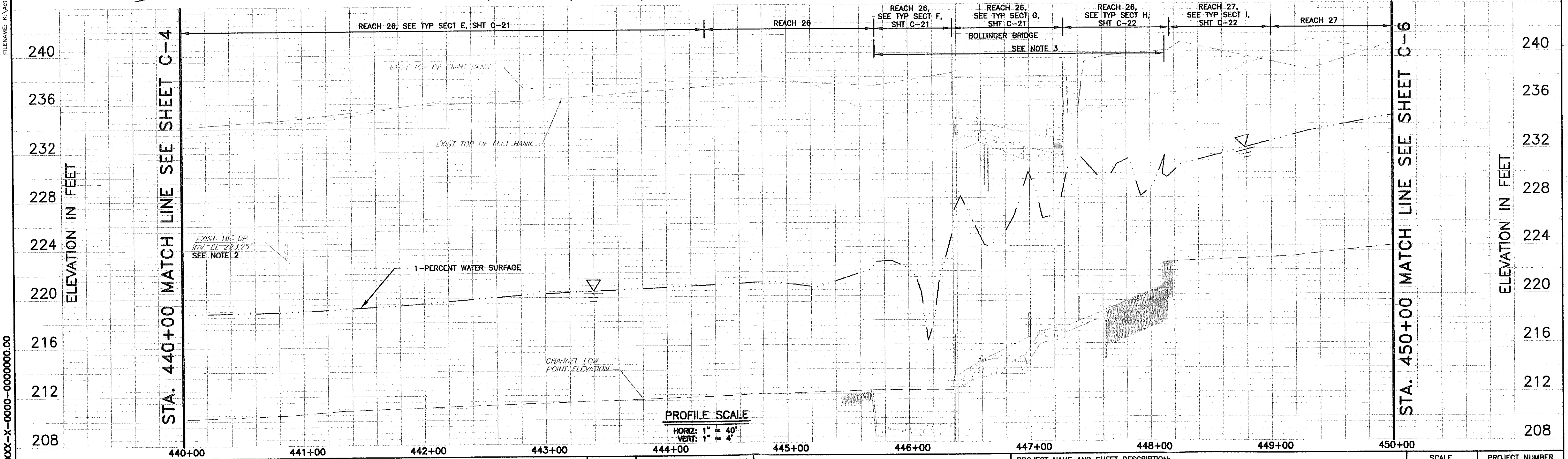
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 430+00 TO 440+00

SCALE	AS SHOWN
PROJECT NUMBER	26104001
VERIFY SCALES	0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
SHEET CODE:	C-4
PAGE NUMBER:	7 OF 30


BROOKWELL DRIVE
BELVEDERE LANE
EAST ESTATES DRIVE
BOLLINGER ROAD
CALABAZAS CREEK
CONTROL LINE
FLOW
440+00
441+00
442+00
443+00
444+00
445+00
446+00
447+00
449+00
450+00
STA. 440+00 MATCH LINE SEE SHEET C-4
STA. 450+00 MATCH LINE SEE SHEET C-6
369-21-012 & NOBUE TOSHIHIKO IZUMIKAWA
JENG YOENG H. APN 369-21-013
WENDY B RICK D & ARMSTRONG APN 369-21-014
JAE Y MOO APN 369-21-015
STEPHEN JONES APN 369-21-016
DOUGLAS G ROWE & CONNIE R APN 369-21-017
MAUREEN C ALAN K & WALKER APN 369-21-018
MUSARAVAKKAM S KRISHNAN APN 369-21-019
CHANG HUA & CHEN YUN JI APN 369-21-020
369-21-021 JOSEPH C & SHARON L SATURNIO
HELENA F ESTEP APN 373-25-025
XUN HU APN 373-25-040
ON-KOK CHANG APN 373-25-041
ROBERT L & WALLACEHEATHER L APN 373-25-042
HOWD & SHERRY L ROBERT A APN 373-25-043
WEIFENG ZHENG APN 373-25-044
KASHYAP K & SANDHA SANDHYA MANGALAPALLY APN 373-25-023
THEODORE Q COFFIN JR. APN 369-22-014
PAUL M TATSUTA APN 369-22-013
WILLIAM S & ANA TSAI APN 369-22-012
LYNN M KEBERLE APN 369-22-011
HOLLY V KHOA T TRAN APN 369-22-010
PHILLIP PAQUETTE APN 369-22-009
YAOPEI CHANG APN 369-22-008
JEFF ACKER APN 369-22-007
ANURADHA YOGENDRA & SINGH APN 369-22-006
LYNN M HOFLAND APN 369-22-005
CONCRETE WEIR
EXIST SACKED CONCRETE
EXIST R/W
EXIST TOP OF BANK
EXIST TOE OF BANK
GROUTED ROCK
WING WALL
ESBM RSP GROUTED ROCK AREA
EXIST CONCRETE RAMP
EXIST ROCKS
EXIST 18" CMP
ROCK WEIR
ECB & HS

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2100 CFS, 10% FLOWRATE 1300 CFS. D/S BOLLINGER ROAD (RAMP) 1% FLOWRATE 2000 CFS, 10% FLOWRATE 1200 CFS.
2. FILL HOLE UNDER 18" DRAIN PIPE WITH 6" ANGULAR ROCKS FOLLOWING FIELD ENGINEER'S DIRECTION.
3. BOLLINGER BRIDGE WATER SURFACE ELEVATION FROM PHYSICAL MODEL

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
R. AGREDA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
No. 56727
Exp. 12/31/09
PROJECT ENGINEER
DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 440+00 TO STA 450+00

SCALE
AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C-5
PAGE NUMBER:
8 OF 30

USERNAME: LUZPENIL Wed 20 Aug 2008 04:52pm
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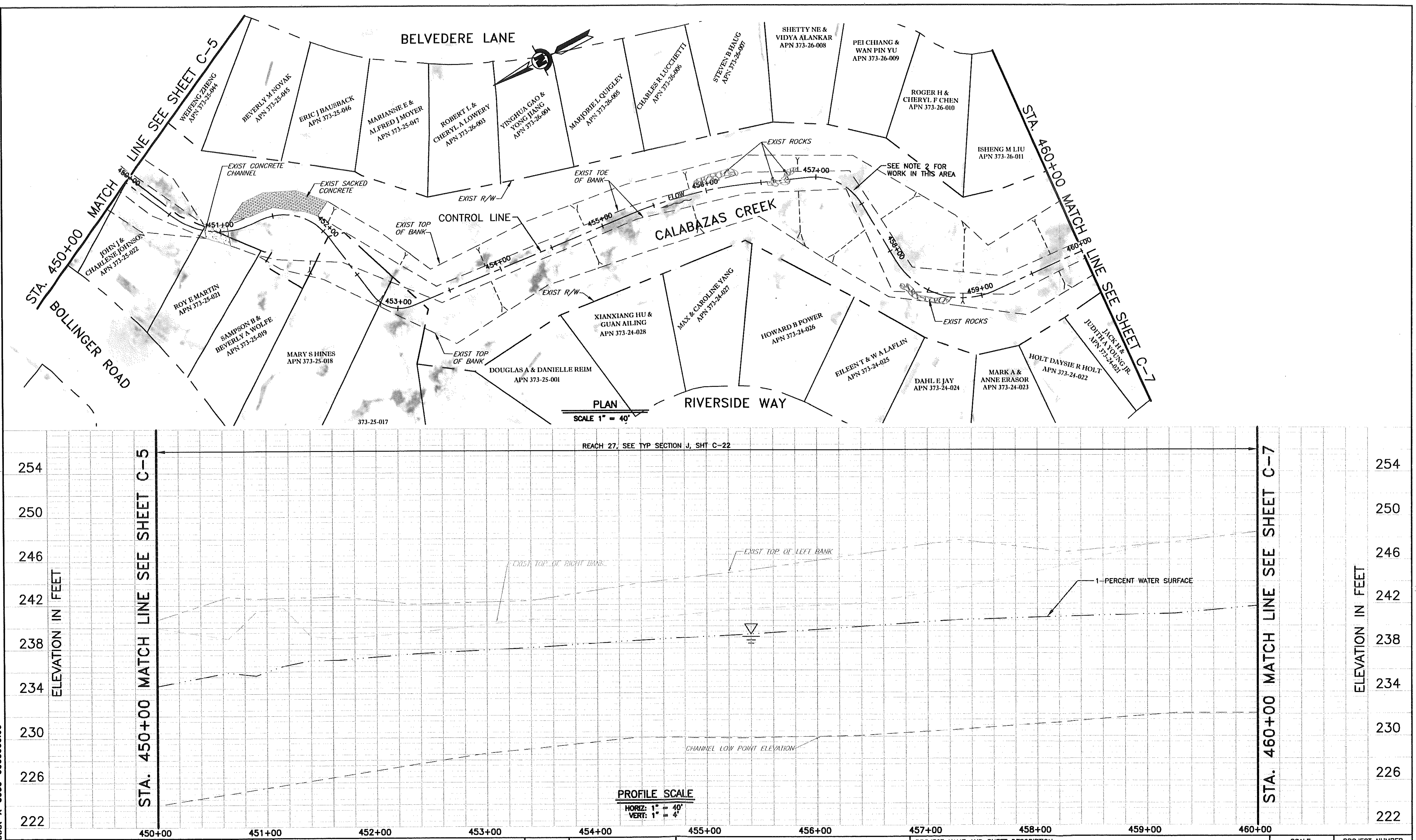
DOCUMENT NUMBER: XXXX-X-0000-0000000.00



BELVEDERE LANE
STA. 450+00 MATCH LINE SEE SHEET C-5
WEIFENG ZHENG APN 373-25-044
BEVERLY M NOVAK APN 373-25-045
ERIC J BAUSBACK APN 373-25-046
MARIANNE E & ALFRED J MOYER APN 373-25-047
ROBERT L & CHERYL A LOWERY APN 373-26-003
YINGHUA GAO & YONG JIANG APN 373-26-004
MARJORIE L QUIGLEY APN 373-26-005
CHARLES R LUCCHETTI APN 373-26-006
STEVEN B HAUG APN 373-26-007
SHETTY NE & VIDYA ALANKAR APN 373-26-008
PEI CHIANG & WAN PIN YU APN 373-26-009
ROGER H & CHERYL F CHEN APN 373-26-010
ISHENG M LIU APN 373-26-011
STA. 460+00 MATCH LINE SEE SHEET C-7
EXIST CONCRETE CHANNEL
EXIST SACKED CONCRETE
EXIST R/W
EXIST TOE OF BANK
EXIST ROCKS
SEE NOTE 2 FOR WORK IN THIS AREA
EXIST TOP OF BANK
CONTROL LINE
FLOW
CALABAZAS CREEK
450+00
451+00
452+00
453+00
454+00
455+00
456+00
457+00
458+00
459+00
460+00
JOHN J & CHARLENE JOHNSON APN 373-25-022
ROY E MARTIN APN 373-25-021
SAMPSON B & BEVERLY A WOLFE APN 373-25-019
MARY S HINES APN 373-25-018
373-25-017
EXIST TOP OF BANK
DOUGLAS A & DANIELLE REIM APN 373-25-001
XIANXIANG HU & GUAN AILING APN 373-24-028
MAX & CAROLINE YANG APN 373-24-027
HOWARD B POWER APN 373-24-026
EILEEN T & W A LAFLIN APN 373-24-025
DAHL E JAY APN 373-24-024
MARK A & ANNE ERASOR APN 373-24-023
HOLT DAYSIE R HOLT APN 373-24-022
JACK H & JUDITH A YOUNG JR. APN 373-24-021
EXIST ROCKS
BOLLINGER ROAD
RIVERSIDE WAY
PLAN
SCALE 1" = 40'
REACH 27, SEE TYP SECTION J, SHT C-22
STA. 450+00 MATCH LINE SEE SHEET C-5
STA. 460+00 MATCH LINE SEE SHEET C-7
ELEVATION IN FEET
254
250
246
242
238
234
230
226
222
EXIST TOP OF RIGHT BANK
EXIST TOP OF LEFT BANK
1-PERCENT WATER SURFACE
CHANNEL LOW POINT ELEVATION
PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'
450+00
451+00
452+00
453+00
454+00
455+00
456+00
457+00
458+00
459+00
460+00

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DOCUMENT NUMBER: XXXX-X-0000-000000.00

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2000 CFS, 10% FLOWRATE 1200 CFS.
2. BETWEEN STA. 456+85 AND STA. 458+20 CLEAR CONCRETE DEBRIS, EXCAVATE POINT BAR AND REARRANGE LOOSE ROCK FOLLOWING FIELD ENGINEER'S DIRECTION.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 58727
Exp. 12/31/09

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 450+00 TO 460+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-6

PAGE NUMBER:
9 OF 30

USERNAME: LUZPENIL Wed 20 Aug 2008 04:55pm
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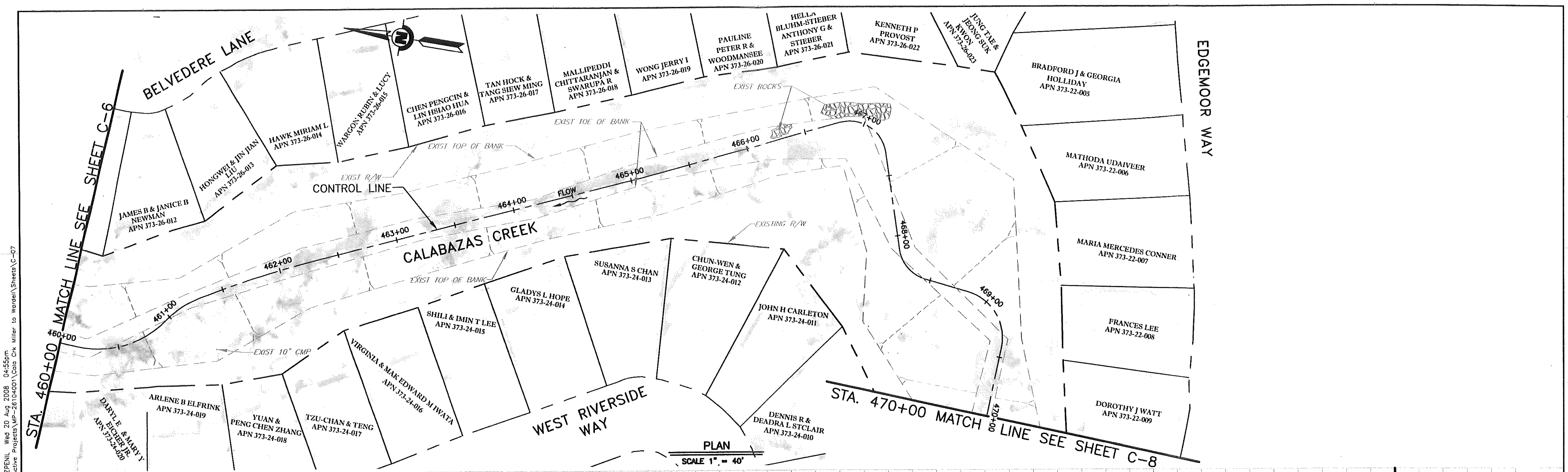
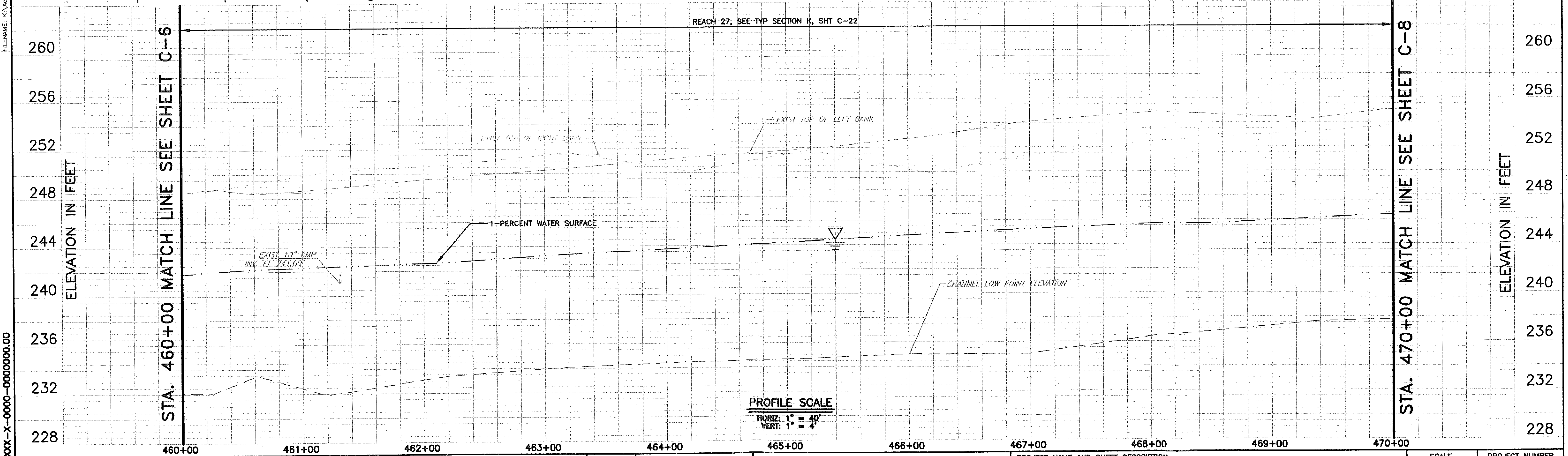

BELVEDERE LANE
EDGEMOOR WAY
WEST RIVERSIDE WAY
CALABAZAS CREEK
CONTROL LINE
FLOW
EXIST R/W
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST ROCKS
EXISTING R/W
EXIST 10" CMP
STA. 460+00 MATCH LINE SEE SHEET C-6
STA. 470+00 MATCH LINE SEE SHEET C-8
460+00
461+00
462+00
463+00
464+00
465+00
466+00
467+00
468+00
469+00
470+00
JAMES B & JANICE B NEWMAN APN 373-26-012
HONGWEI & JIN JIAN LIU APN 373-26-013
HAWK MIRIAM L APN 373-26-014
WARGON RUBIN & LUCY APN 373-26-015
CHEN PENGCIN & LIN HSIAO HUA APN 373-26-016
TAN HOCK & TANG SIEW MING APN 373-26-017
MALLIPEDDI CHITTARANJAN & SWARUPA R APN 373-26-018
WONG JERRY I APN 373-26-019
PAULINE PETER R & WOODMANSEE APN 373-26-020
HELLA BLUHM-STIEBER ANTHONY G & STIEBER APN 373-26-021
KENNETH P PROVOST APN 373-26-022
JUNG TAE & JEONG SUK KWON APN 373-26-023
BRADFORD J & GEORGIA HOLLIDAY APN 373-22-005
MATHODA UDAIVEER APN 373-22-006
MARIA MERCEDES CONNER APN 373-22-007
FRANCES LEE APN 373-22-008
DOROTHY J WATT APN 373-22-009
DARYLE E & MARY Y EICHER JR. APN 373-24-020
ARLENE B ELFRINK APN 373-24-019
YUAN & PENG CHEN ZHANG APN 373-24-018
TZU-CHAN & TENG APN 373-24-017
VIRGINIA & MAK EDWARD M IWATA APN 373-24-016
SHILI & IMIN T LEE APN 373-24-015
GLADYS L HOPE APN 373-24-014
SUSANNA S CHAN APN 373-24-013
CHUN-WEN & GEORGE TUNG APN 373-24-012
JOHN H CARLETON APN 373-24-011
DENNIS R & DEADRA L STCLAIR APN 373-24-010
PLAN
SCALE 1" = 40'



REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2000 CFS, 10% FLOWRATE 1200 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 50727
Exp. 12/31/09

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE

STA 460+00 TO STA 470+00

SCALE: AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26104001

SHEET CODE: C-7

PAGE NUMBER: 10 OF 30

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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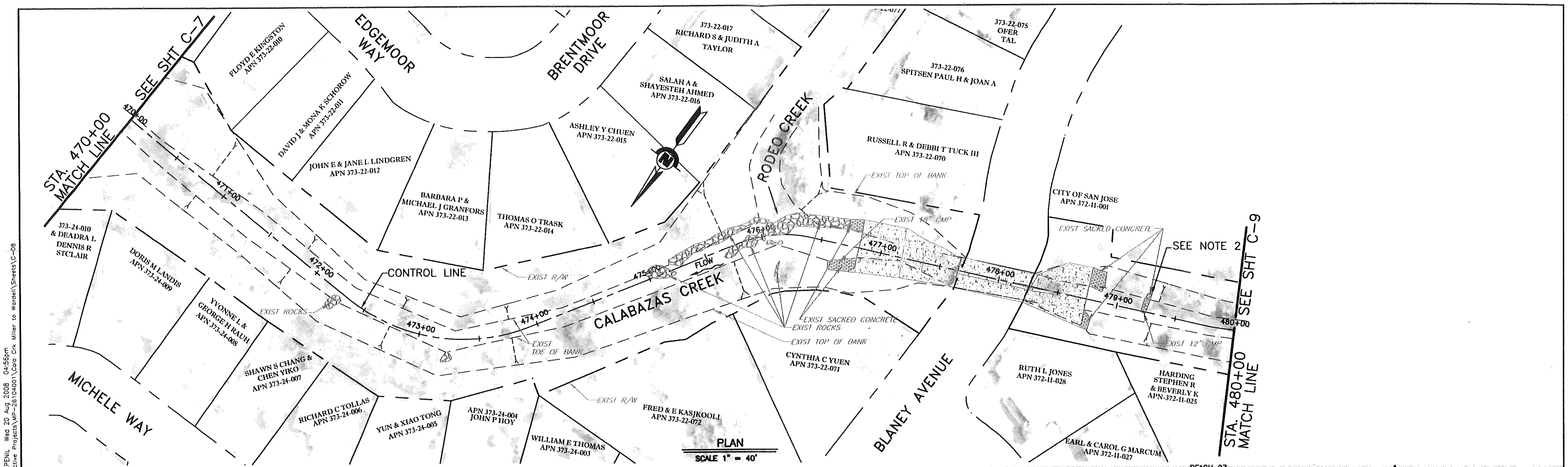
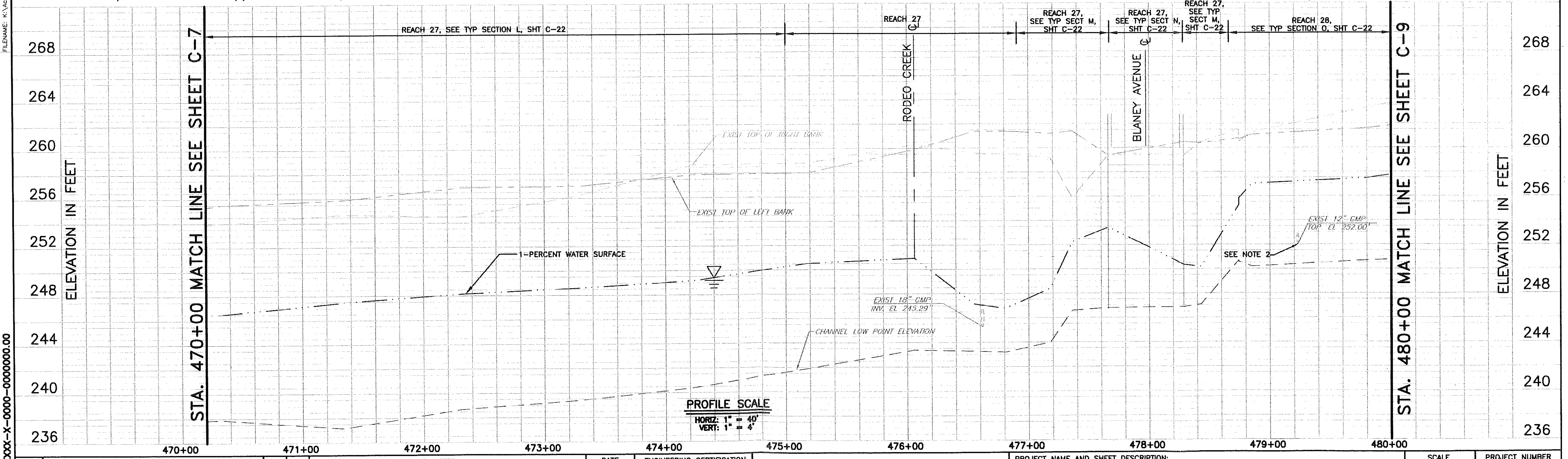

STA. 470+00 MATCH LINE
SEE SHT C-7
470+00
471+00
472+00
473+00
474+00
475+00
476+00
477+00
478+00
479+00
480+00
EDGEMOOR WAY
BRENTMOOR DRIVE
MICHELE WAY
BLANEY AVENUE
RODEO CREEK
CALABAZAS CREEK
FLOW
CONTROL LINE
EXIST R/W
EXIST ROCKS
EXIST TOE OF BANK
EXIST TOP OF BANK
EXIST 18" CMP
EXIST SACKED CONCRETE
EXIST SACKED CONCRETE
EXIST ROCKS
EXIST TOP OF BANK
EXIST R/W
SEE NOTE 2
EXIST 12" CMP
N
FLOYD E KINGSTON APN 373-22-010
DAVID J & MONA K SCHOROW APN 373-22-011
JOHN E & JANE L LINDGREN APN 373-22-012
BARBARA P & MICHAEL J GRANFORS APN 373-22-013
THOMAS O TRASK APN 373-22-014
ASHLEY Y CHUEN APN 373-22-015
SALAH A & SHAYESTEH AHMED APN 373-22-016
373-22-017 RICHARD S & JUDITH A TAYLOR
373-22-075 OFER TAL
373-22-076 SPITSEN PAUL H & JOAN A
RUSSELL R & DEBBI T TUCK III APN 373-22-070
CITY OF SAN JOSE APN 372-11-001
373-24-010 & DEADRA L DENNIS R STCLAIR
DORIS M LANDIS APN 373-24-009
YVONNE L & GEORGE H RAUH APN 373-24-008
SHAWN S CHANG & CHEN YIKO APN 373-24-007
RICHARD C TOLLAS APN 373-24-006
YUN & XIAO TONG APN 373-24-005
APN 373-24-004 JOHN P HOY
WILLIAM E THOMAS APN 373-24-003
FRED & E KASJKOOLI APN 373-22-072
CYNTHIA C YUEN APN 373-22-071
RUTH L JONES APN 372-11-028
HARDING STEPHEN R & BEVERLY K APN-372-11-025
EARL & CAROL G MARCUM APN 372-11-027
STA. 480+00 MATCH LINE
SEE SHT C-9

PLAN
SCALE 1" = 40'


REACH 27, SEE TYP SECTION L, SHT C-22
REACH 27
RODEO CREEK ℄
REACH 27, SEE TYP SECT M, SHT C-22
REACH 27, SEE TYP SECT N, SHT C-22
BLANEY AVENUE ℄
REACH 27, SEE TYP SECT M, SHT C-22
REACH 28, SEE TYP SECTION O, SHT C-22
STA. 470+00 MATCH LINE SEE SHEET C-7
STA. 480+00 MATCH LINE SEE SHEET C-9
ELEVATION IN FEET
268
264
260
256
252
248
244
240
236
EXIST TOP OF RIGHT BANK
EXIST TOP OF LEFT BANK
1-PERCENT WATER SURFACE
EXIST 18" CMP INV. EL 245.29'
CHANNEL LOW POINT ELEVATION
EXIST 12" CMP TOP EL 252.00'
SEE NOTE 2
470+00
471+00
472+00
473+00
474+00
475+00
476+00
477+00
478+00
479+00
480+00

PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 2000 CFS, 10% FLOWRATE 1200 CFS. U/S RODEO CREEK 1% FLOWRATE 1600 CFS, 10% FLOWRATE 980 CFS.
2. CUT SLUMPED SACKED CONCRETE AT BACK LINE AND SMOOTH OUT TRANSITIONS WITH 2" GRAVEL FOLLOWING FIELD ENGINEER'S DIRECTION.

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
R. AGREDA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 59727
Exp. 12/31/09
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 470+00 TO STA 480+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

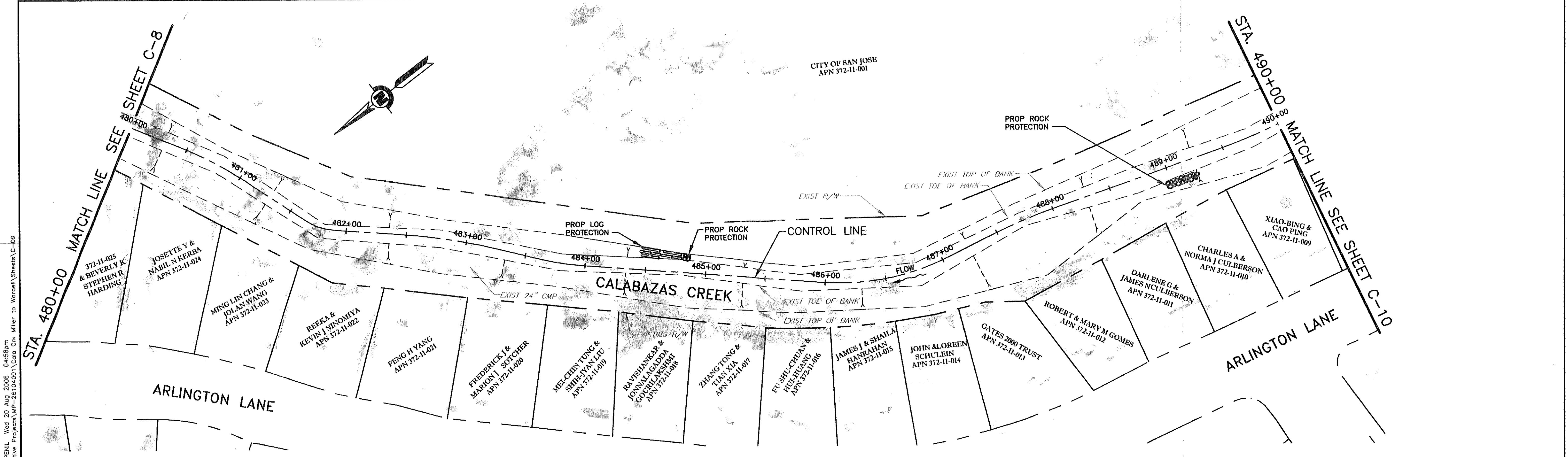
PROJECT NUMBER
26104001

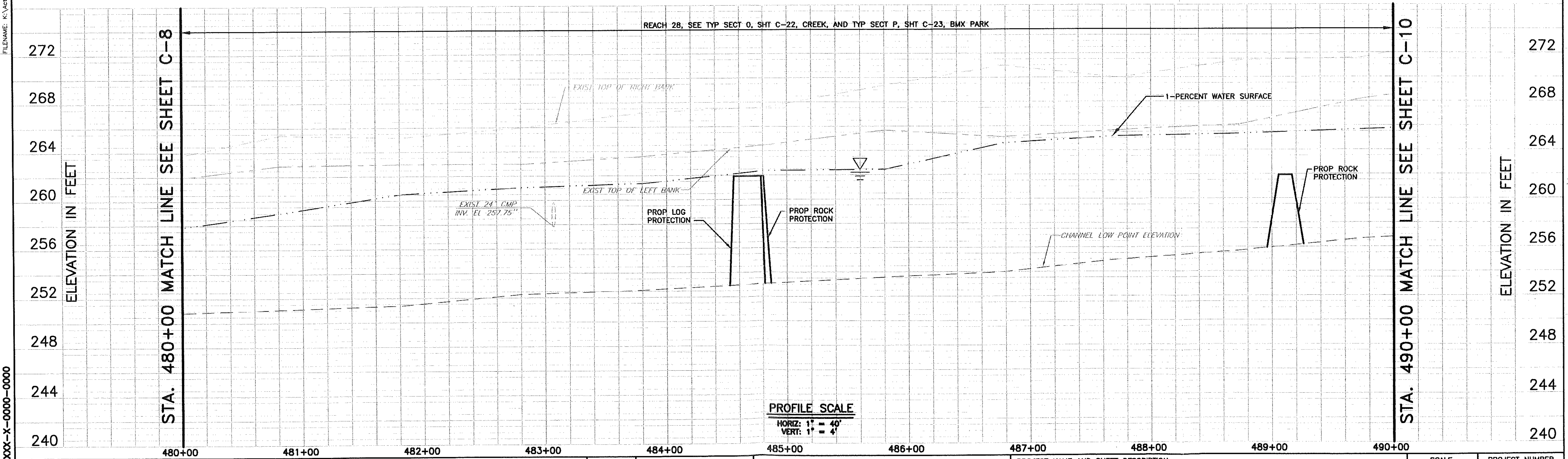
SHEET CODE:
C-8

PAGE NUMBER:
11 OF 30

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

USERNAME: LUZPENIL Wed 20 Aug 2008 04:58pm
FILENAME: K:\Active Projects\MP-26104001\Cala Crk Miller to Wardell\Sheets\C-09


STA. 480+00 MATCH LINE SEE SHEET C-8
STA. 490+00 MATCH LINE SEE SHEET C-10
CITY OF SAN JOSE
APN 372-11-001
PROP ROCK PROTECTION
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST R/W
PROP LOG PROTECTION
PROP ROCK PROTECTION
CONTROL LINE
CALABAZAS CREEK
FLOW
EXIST 24" CMP
EXIST TOE OF BANK
EXIST TOP OF BANK
EXISTING R/W
480+00
481+00
482+00
483+00
484+00
485+00
486+00
487+00
488+00
489+00
490+00
372-11-025 & BEVERLY K STEPHEN R HARDING
JOSETTE Y & NABIL N KERBA APN 372-11-024
MING LIN CHANG & JOLAN WANG APN 372-11-023
REEKA & KEVIN J NINOMIYA APN 372-11-022
FENG H YANG APN 372-11-021
FREDERICK J & MARION J SOTCHER APN 372-11-020
MELCHIN TUNG & SHIH-YAN LIU APN 372-11-019
RAVISHANKAR & JONNALAGADDA GOURILAKSHMI APN 372-11-018
ZHANG TONG & TIAN XIA APN 372-11-017
FU SHU-CHUAN & HUI HUANG APN 372-11-016
JAMES J & SHAILA HANRAHAN APN 372-11-015
JOHN & LOREEN SCHULEIN APN 372-11-014
GATES 2000 TRUST APN 372-11-013
ROBERT & MARY M GOMES APN 372-11-012
DARLENE G & JAMES N CULBERSON APN 372-11-011
CHARLES A & NORMA J CULBERSON APN 372-11-010
XIAO-BING & CAO PING APN 372-11-009
ARLINGTON LANE
ARLINGTON LANE



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1600 CFS, 10% FLOWRATE 980 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 38727
Exp. 12/31/09
CIVIL

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 480+00 TO STA 490+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-9

USERNAME: LUZPENIL Wed 20 Aug 2008 06:19pm
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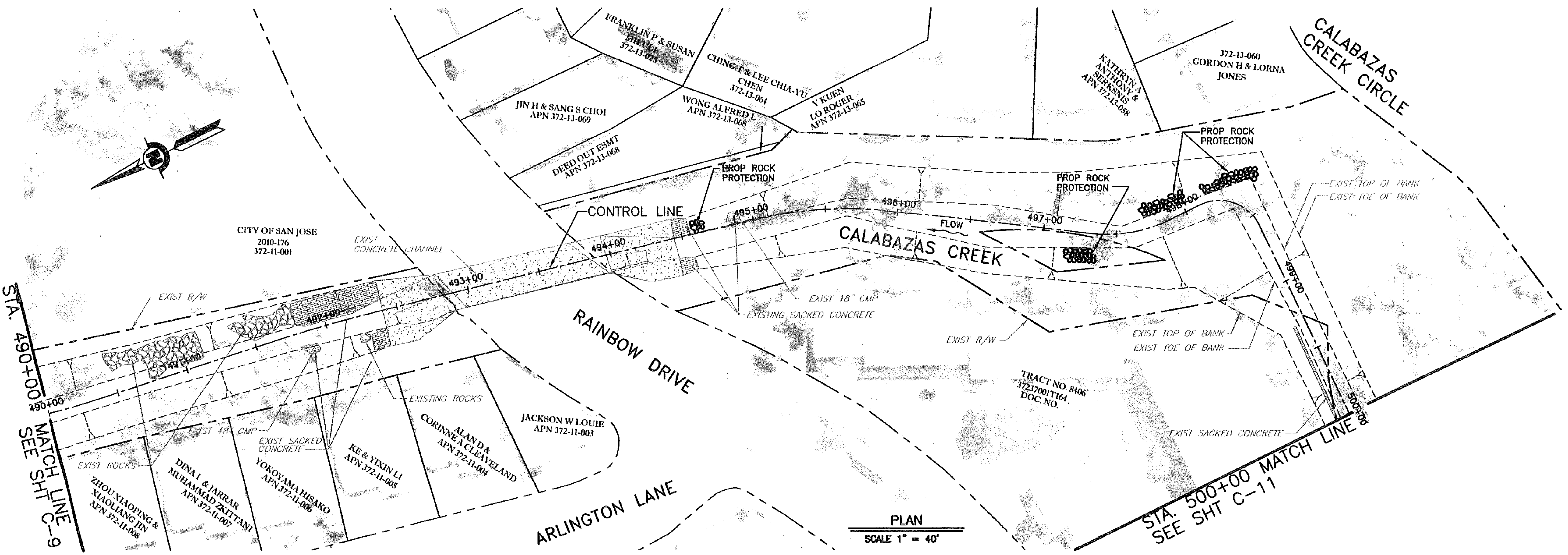
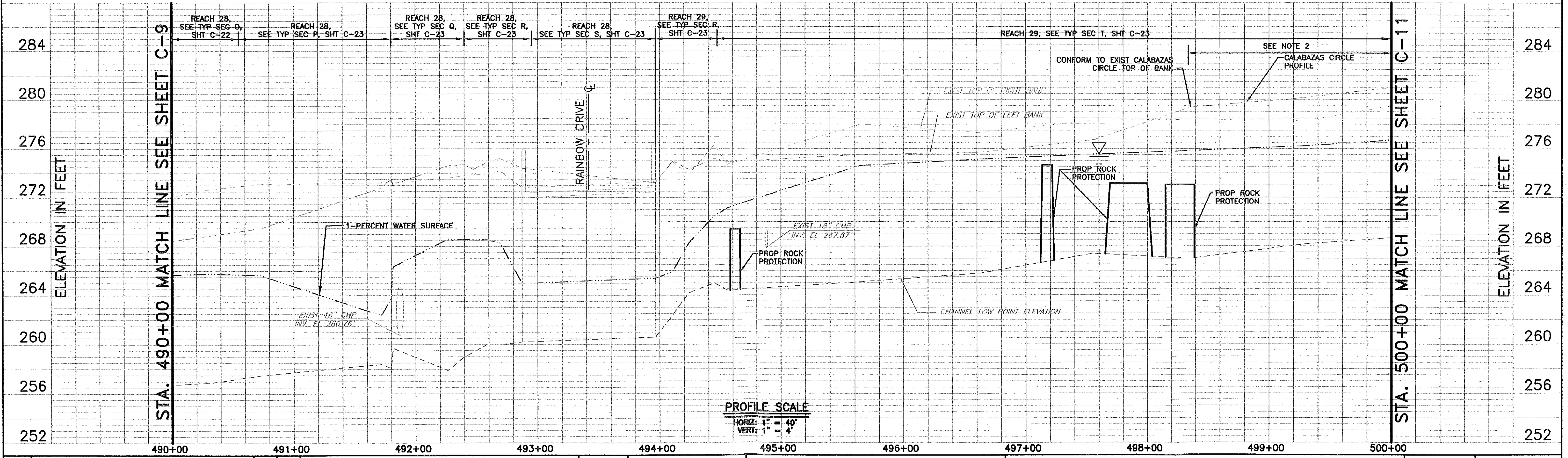

FRANKLIN P & SUSAN MIEULI 372-13-025
CHING T & LEE CHIA-YU CHEN 372-13-064
Y KUEN LO ROGER APN 372-13-065
WONG ALFRED L APN 372-13-068
JIN H & SANG S CHOI APN 372-13-069
DEED OUT ESMT APN 372-13-068
KATHRYN A ANTHONY & SERKSNIS APN 372-13-058
372-13-060 GORDON H & LORNA JONES
CALABAZAS CREEK CIRCLE
PROP ROCK PROTECTION
CONTROL LINE
CITY OF SAN JOSE 2010-176 372-11-001
EXIST CONCRETE CHANNEL
EXIST R/W
CALABAZAS CREEK
FLOW
490+00
491+00
492+00
493+00
494+00
495+00
496+00
497+00
498+00
499+00
500+00
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST 18" CMP
EXISTING SACKED CONCRETE
RAINBOW DRIVE
TRACT NO. 8406 37237001T164, DOC. NO.
STA. 490+00 MATCH LINE SEE SHT C-9
EXIST 48" CMP
EXIST SACKED CONCRETE
EXISTING ROCKS
EXIST ROCKS
JACKSON W LOUIE APN 372-11-003
ALAN D & CORINNE A CLEAVELAND APN 372-11-004
KE & YIXIN LI APN 372-11-005
YOKOYAMA HISAKO APN 372-11-006
DINA I & JARRAR MUHAMMAD ZKITTANI APN 372-11-007
ZHOU XIAOPING & XIAOLIANG JIN APN 372-11-008
ARLINGTON LANE
STA. 500+00 MATCH LINE SEE SHT C-11

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1600 CFS, 10% FLOWRATE 980 CFS. D/S RAINBOW OUTFALL 1% FLOWRATE 1540 CFS, 10% FLOWRATE 920 CFS.
2. CALABAZAS CIRCLE TOP OF BANK IS USED AS TOP OF CALABAZAS CREEK LT BANK ELEVATION.

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
R. AGREDA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
CIVIL
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 490+00 TO STA 500+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-10

PAGE NUMBER:
13 OF 30

USERNAME: LUZPENIL Wed 20 Aug 2008 05:10pm
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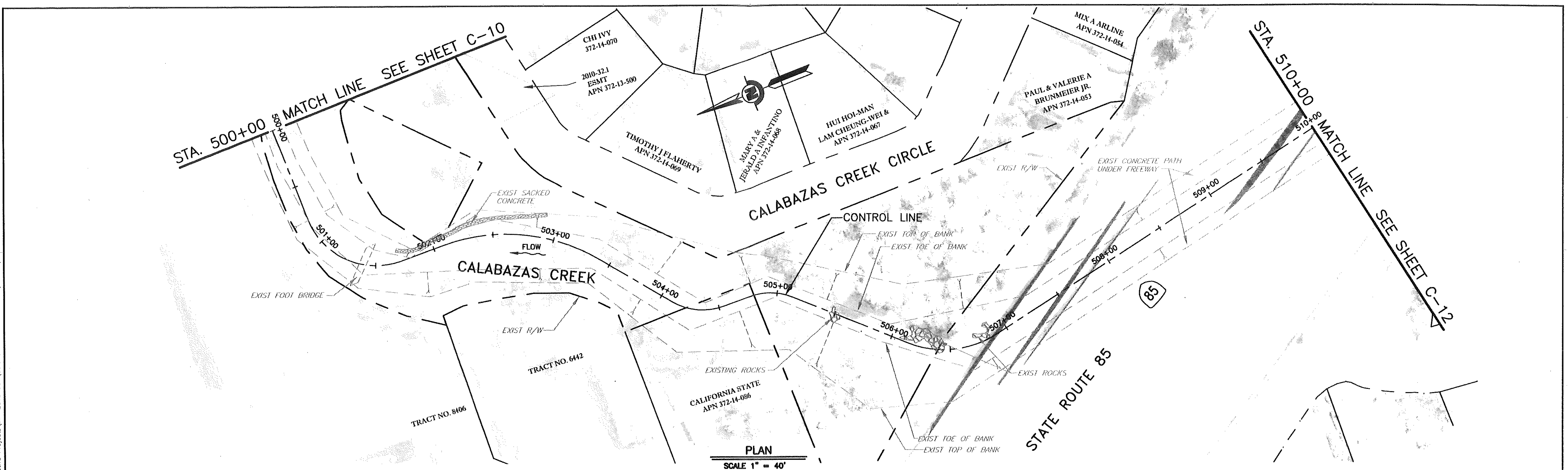
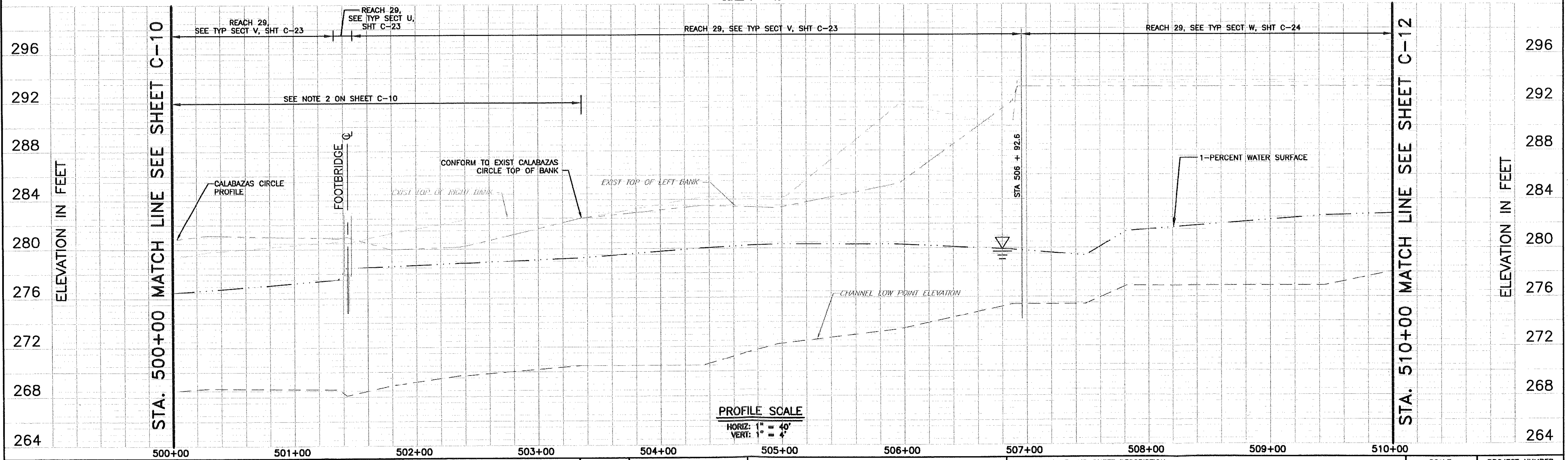

STA. 500+00 MATCH LINE SEE SHEET C-10
500+00
CHI IVY 372-14-070
2010-32.1 ESMT APN 372-13-500
TIMOTHY J FLAHERTY APN 372-14-069
MARY A & JERALD A INFANTINO APN 372-14-068
HUI HOI-MAN LAM CHEUNG-WEI & APN 372-14-067
MIX A ARLINE APN 372-14-054
PAUL & VALERIE A BRUNMEIER JR. APN 372-14-053
STA. 510+00 MATCH LINE SEE SHEET C-12
510+00
CALABAZAS CREEK CIRCLE
EXIST SACKED CONCRETE
501+00
502+00
503+00
FLOW
CALABAZAS CREEK
504+00
505+00
506+00
507+00
508+00
509+00
EXIST FOOT BRIDGE
EXIST R/W
CONTROL LINE
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST CONCRETE PATH UNDER FREEWAY
EXIST R/W
85
TRACT NO. 6442
TRACT NO. 8406
EXISTING ROCKS
CALIFORNIA STATE APN 372-14-086
EXIST ROCKS
STATE ROUTE 85
EXIST TOE OF BANK
EXIST TOP OF BANK

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1540 CFS, 10% FLOWRATE 920 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE No. 50727

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 500+00 TO STA 510+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-11

PAGE NUMBER:
14 OF 30

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

USERNAME: LUZPENIL Wed 20 Aug 2008 05:12pm
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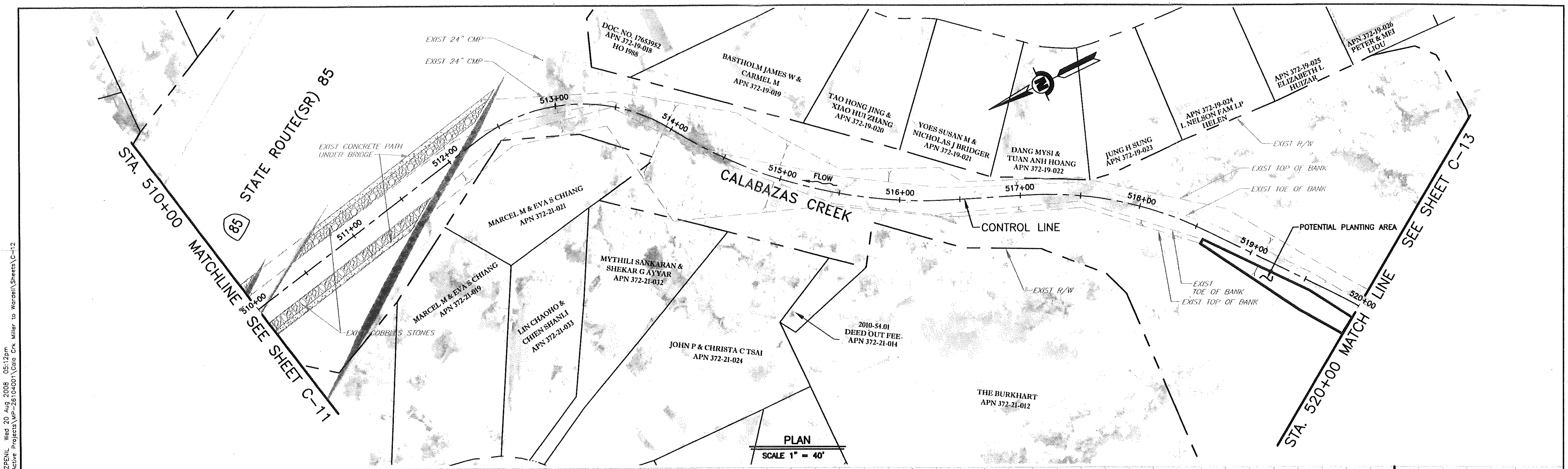
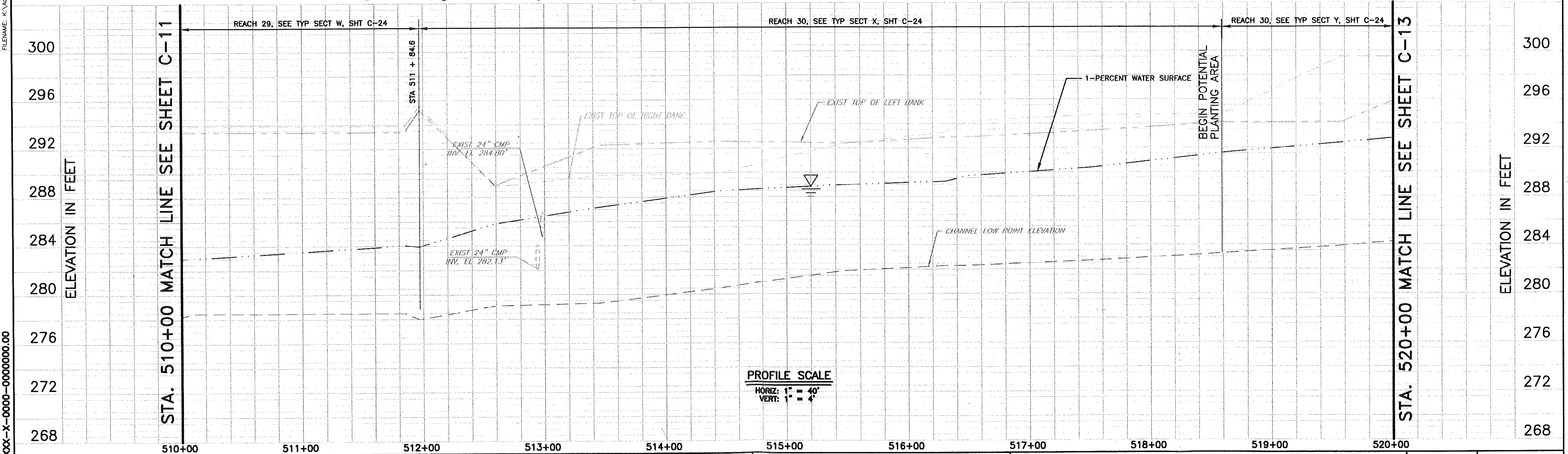


EXIST 24" CMP
EXIST 24" CMP
DOC. NO. 17653952 APN 372-19-018 HO 1988
BASTHOLM JAMES W & CARMEL M APN 372-19-019
TAO HONG JING & XIAO HUI ZHANG APN 372-19-020
YOES SUSAN M & NICHOLAS J BRIDGER APN 372-19-021
DANG MYSI & TUAN ANH HOANG APN 372-19-022
JUNG H SUNG APN 372-19-023
APN 372-19-024 L NELSON FAM LP HELEN
APN 372-19-025 ELIZABETH L HUIZAR
APN 372-19-026 PETER & MEI LIOU
STATE ROUTE(SR) 85
85
EXIST CONCRETE PATH UNDER BRIDGE
513+00
514+00
515+00
FLOW
516+00
517+00
518+00
519+00
520+00
512+00
511+00
510+00
CALABAZAS CREEK
CONTROL LINE
EXIST R/W
EXIST TOP OF BANK
EXIST TOE OF BANK
POTENTIAL PLANTING AREA
STA. 510+00 MATCHLINE SEE SHEET C-11
STA. 520+00 MATCH LINE SEE SHEET C-13
MARCEL M & EVA S CHIANG APN 372-21-021
MARCEL M & EVA S CHIANG APN 372-21-019
MYTHILI SANKARAN & SHEKAR G AYYAR APN 372-21-032
LIN CHAOHO & CHEN SHANLI APN 372-21-033
JOHN P & CHRISTA C TSAI APN 372-21-024
2010-54.01 DEED OUT FEE. APN 372-21-014
THE BURKHART APN 372-21-012
EXIST R/W
EXIST TOE OF BANK
EXIST TOP OF BANK
EXIST COBBLES STONES
PLAN
SCALE 1" = 40'



REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1470 CFS, 10% FLOWRATE 860 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 59727
Exp. 12/31/09
CIVIL

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 510+00 TO 520+00

SCALE AS SHOWN	PROJECT NUMBER 26104001
VERIFY SCALES 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	SHEET CODE: C-12 PAGE NUMBER: 15 OF 30

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

USERNAME: LUZPENIL Wed 20 Aug 2008 05:14pm
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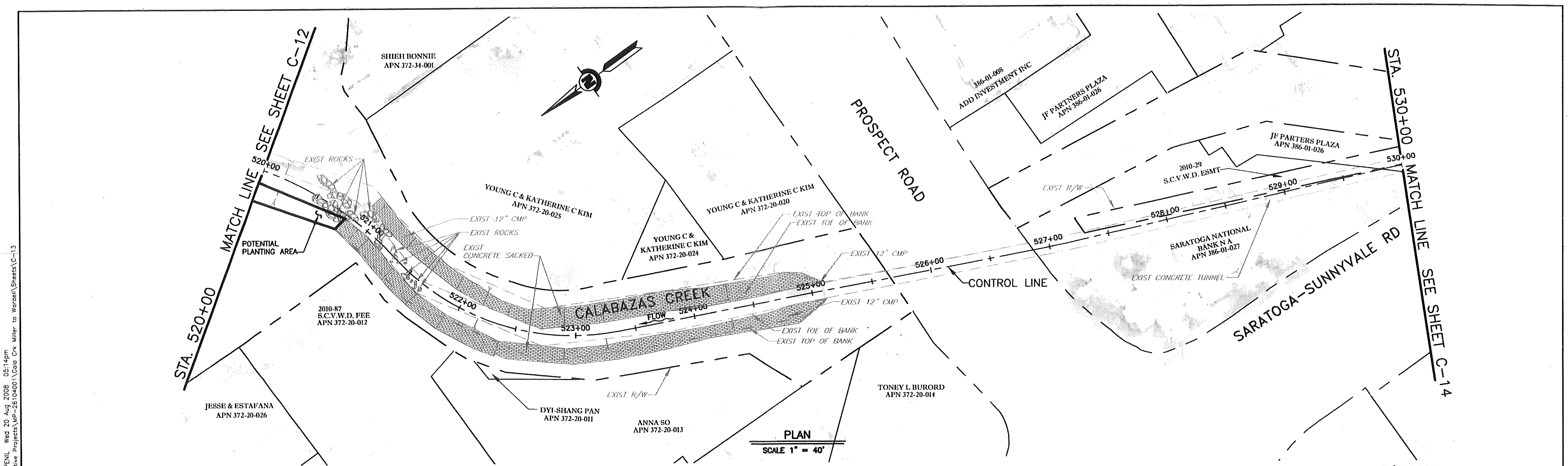
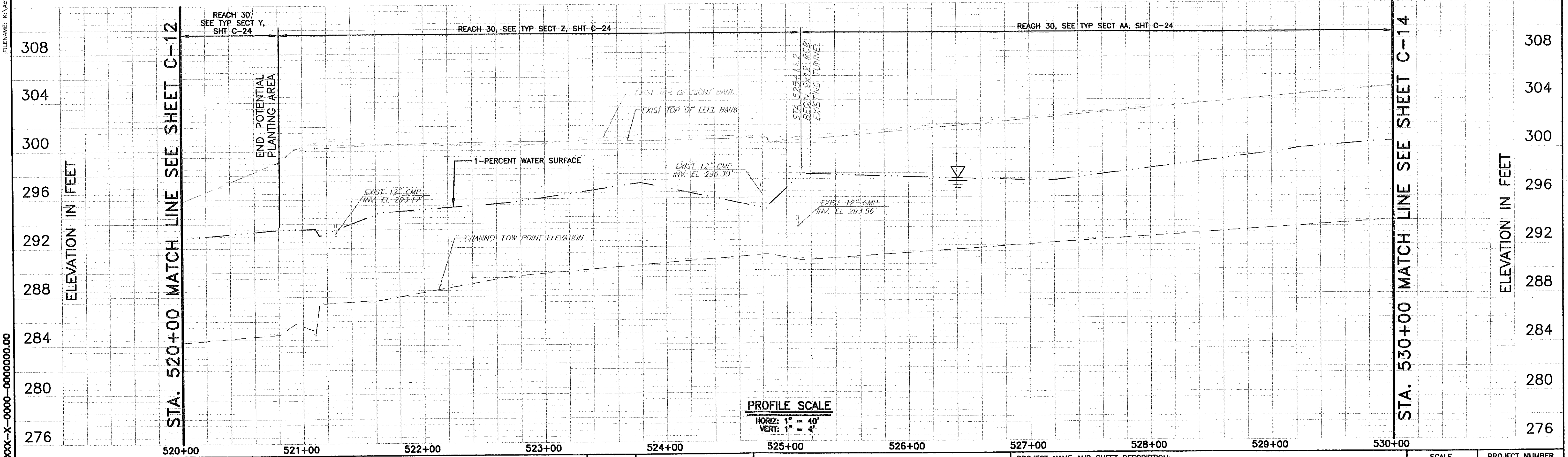


MATCH LINE SEE SHEET C-12
STA. 520+00
SHIEH BONNIE APN 372-34-001
YOUNG C & KATHERINE C KIM APN 372-20-025
YOUNG C & KATHERINE C KIM APN 372-20-024
YOUNG C & KATHERINE C KIM APN 372-20-020
PROSPECT ROAD
386-01-008 ADD INVESTMENT INC
JF PARTNERS PLAZA APN 386-01-026
JF PARTERS PLAZA APN 386-01-026
2010-29 S.C.V.W.D. ESMT
SARATOGA NATIONAL BANK N A APN 386-01-027
SARATOGA-SUNNYVALE RD
STA. 530+00 MATCH LINE SEE SHEET C-14
EXIST ROCKS
POTENTIAL PLANTING AREA
EXIST 12" CMP
EXIST CONCRETE SACKED
CALABAZAS CREEK
FLOW
EXIST TOP OF BANK
EXIST TOE OF BANK
CONTROL LINE
EXIST R/W
EXIST CONCRETE TUNNEL
2010-87 S.C.V.W.D. FEE APN 372-20-012
JESSE & ESTAFANA APN 372-20-026
DYI-SHANG PAN APN 372-20-011
ANNA SO APN 372-20-013
TONEY L BURORD APN 372-20-014
520+00
521+00
522+00
523+00
524+00
525+00
526+00
527+00
528+00
529+00
530+00

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1470 CFS, 10% FLOWRATE 860 CFS. UNDER THE TUNNEL 1% FLOWRATE 1400 CFS, 10% FLOWRATE 800 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 59727
Exp. 12/31/09
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 520+00 TO STA 530+00

SCALE: AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26104001

SHEET CODE: C-13

PAGE NUMBER: 16 OF 30

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

USERNAME: LUZPENIL Wed 20 Aug 2008 05:16pm
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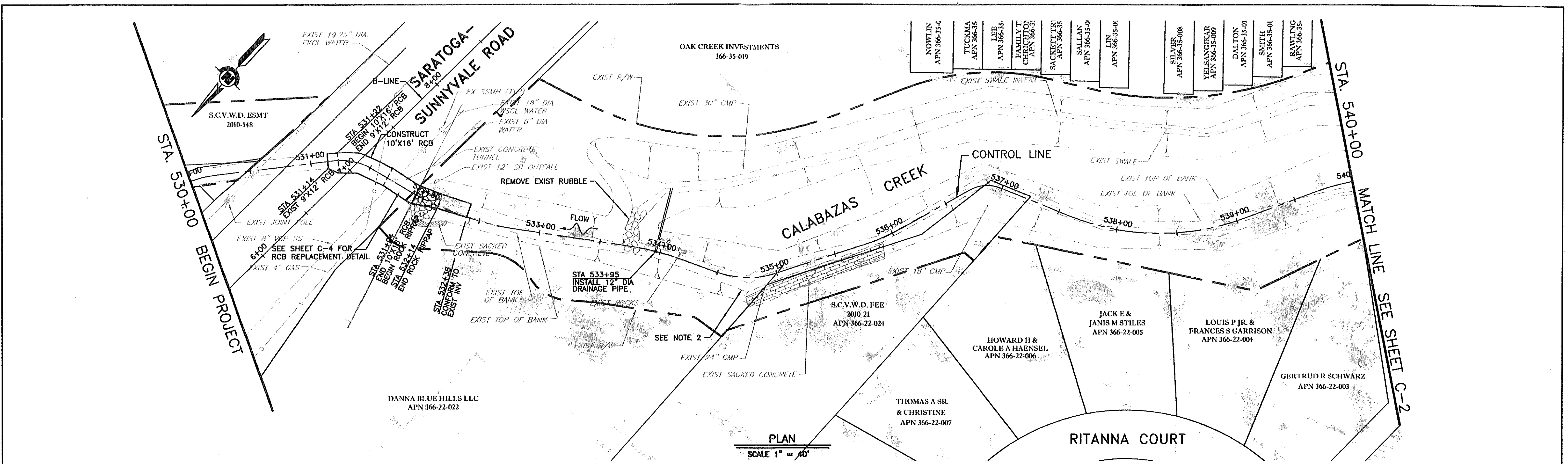
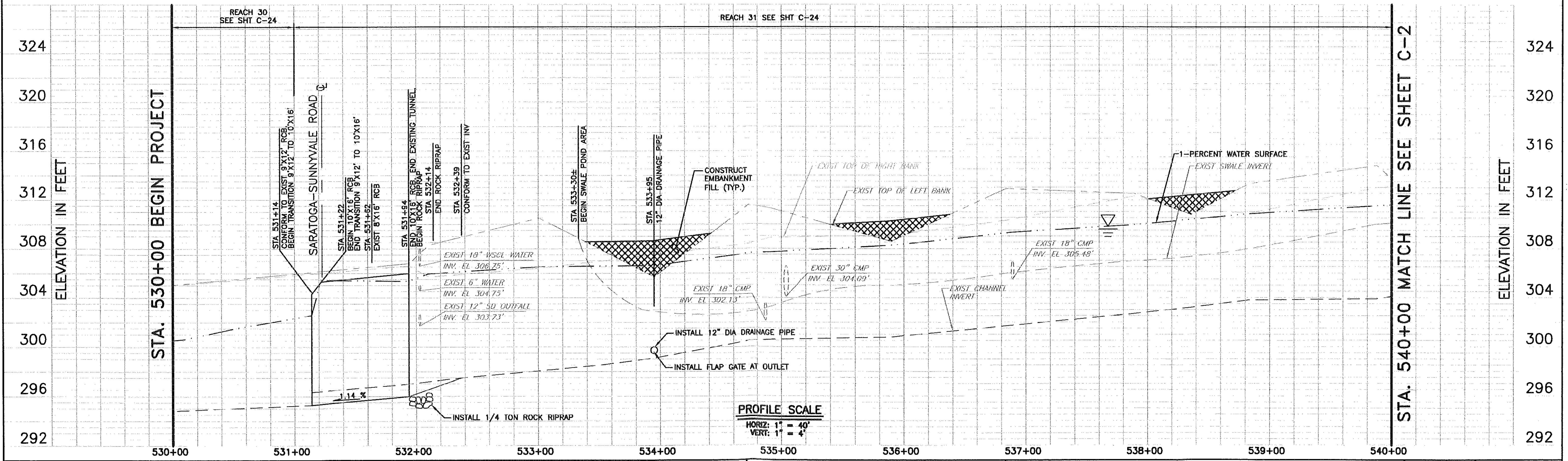

OAK CREEK INVESTMENTS 366-35-019
SARATOGA-SUNNYVALE ROAD
B-LINE 8+00
S.C.V.W.D. ESMT 2010-148
STA. 530+00 BEGIN PROJECT
STA. 540+00 MATCH LINE SEE SHEET C-2
CALABAZAS CREEK
CONTROL LINE
REMOVE EXIST RUBBLE
FLOW
CONSTRUCT 10'X16' RCB
SEE SHEET C-4 FOR RCB REPLACEMENT DETAIL
STA 533+95 INSTALL 12" DIA DRAINAGE PIPE
SEE NOTE 2
S.C.V.W.D. FEE 2010-21 APN 366-22-024
DANNA BLUE HILLS LLC APN 366-22-022
HOWARD H & CAROLE A HAENSEL APN 366-22-006
JACK E & JANIS M STILES APN 366-22-005
LOUIS P JR. & FRANCES S GARRISON APN 366-22-004
GERTRUD R SCHWARZ APN 366-22-003
THOMAS A SR. & CHRISTINE APN 366-22-007
RITANNA COURT
PLAN
SCALE 1" = 40'



REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

NOTE:
1. 1% FLOWRATE 1,400 CFS AT 10% FLOWRATE 800 CFS.
2. FILL GAP BETWEEN SACKED CONCRETE AND TREE WITH 6" COBBLES PER FIELD ENGINEER'S DIRECTION.

DATE AUG 08
DESIGN P. GHARIB
DRAWN R. AGREDA
CHECKED L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 50727
Exp. 12/31/09
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 530+00 TO 540+00

SCALE: AS SHOWN
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26104001
SHEET CODE: C-14

USERNAME: LUZPENIL Wed 20 Aug 2008 05:34pm
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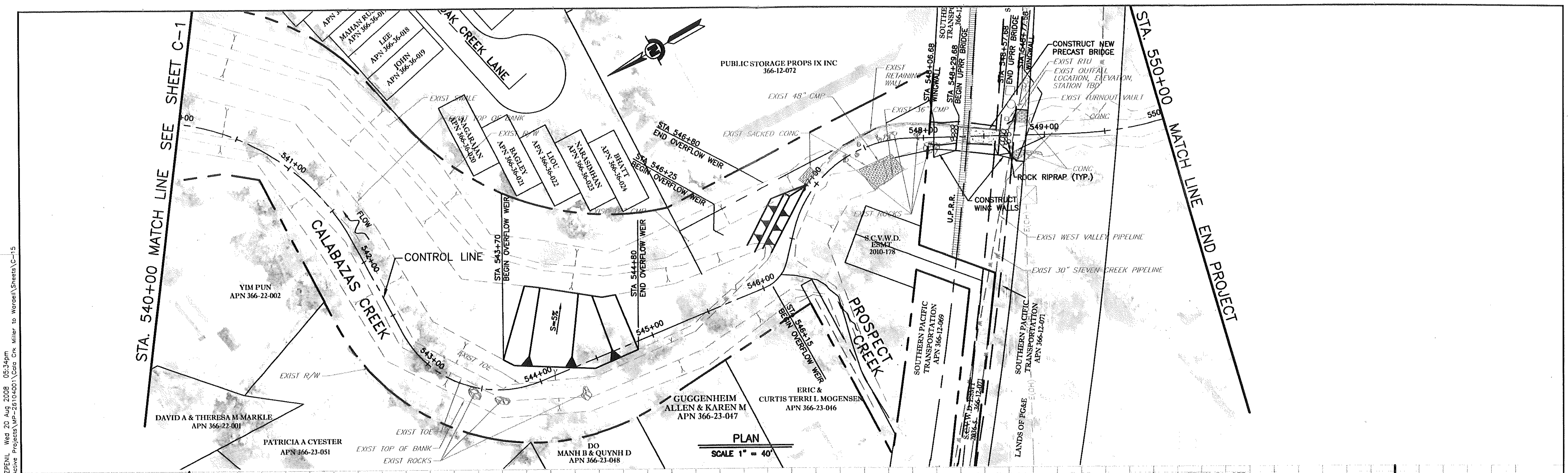

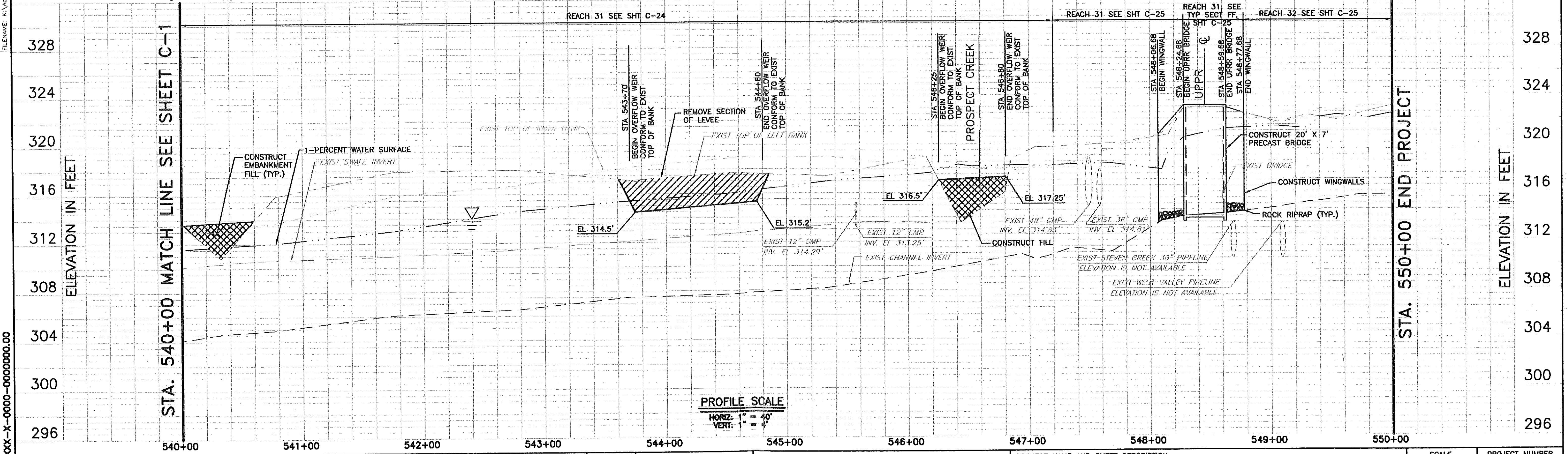

REACH 31 SEE SHT C-24
REACH 31 SEE SHT C-25
REACH 31, SEE TYP SECT FF, SHT C-25
REACH 32 SEE SHT C-25
ELEVATION IN FEET
328
324
320
316
312
308
304
300
296
STA. 540+00 MATCH LINE SEE SHEET C-1
STA. 550+00 END PROJECT
CONSTRUCT EMBANKMENT FILL (TYP.)
1-PERCENT WATER SURFACE
EXIST SWALE INVERT
EXIST TOP OF RIGHT BANK
STA 543+70 BEGIN OVERFLOW WEIR CONFORM TO EXIST TOP OF BANK
REMOVE SECTION OF LEVEE
EXIST TOP OF LEFT BANK
STA 544+80 END OVERFLOW WEIR CONFORM TO EXIST TOP OF BANK
EL 314.5'
EL 315.2'
EXIST 12" CMP INV. EL 314.29'
EXIST 12" CMP INV. EL 313.25'
STA 546+25 BEGIN OVERFLOW WEIR CONFORM TO EXIST TOP OF BANK
PROSPECT CREEK
STA 546+80 END OVERFLOW WEIR CONFORM TO EXIST TOP OF BANK
EL 316.5'
EL 317.25'
CONSTRUCT FILL
EXIST CHANNEL INVERT
EXIST 48" CMP INV. EL 314.83'
EXIST 36" CMP INV. EL 314.87'
EXIST STEVEN CREEK 30" PIPELINE ELEVATION IS NOT AVAILABLE
EXIST WEST VALLEY PIPELINE ELEVATION IS NOT AVAILABLE
STA 548+06.68 BEGIN WINGWALL
STA 548+24.68 BEGIN UPRR BRIDGE
UPRR ℄
STA 548+59.68 END UPRR BRIDGE
STA 548+77.68 END WINGWALL
CONSTRUCT 20' X 7' PRECAST BRIDGE
EXIST BRIDGE
CONSTRUCT WINGWALLS
ROCK RIPRAP (TYP.)
PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'
540+00
541+00
542+00
543+00
544+00
545+00
546+00
547+00
548+00
549+00
550+00

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1,330 CFS AT SARATOGA-SUNNYVALE ROAD
   1% FLOWRATE 1,100 CFS AT UPRR

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
R. AGREDA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 50727
Exp. 12/31/09
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 540+00 TO STA 550+00

SCALE
AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C-15
PAGE NUMBER:
18 OF 30

DOCUMENT NUMBER: XXXX-X-0000-000000.00

USERNAME: LUZPENIL Wed 20 Aug 2008 05:36pm
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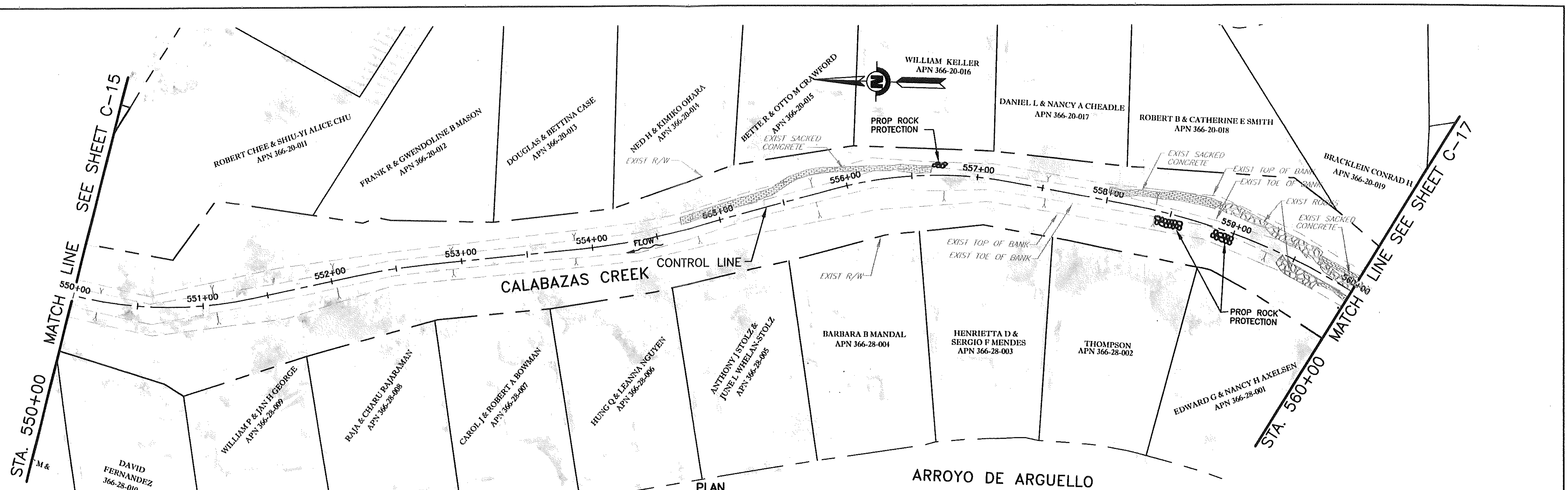
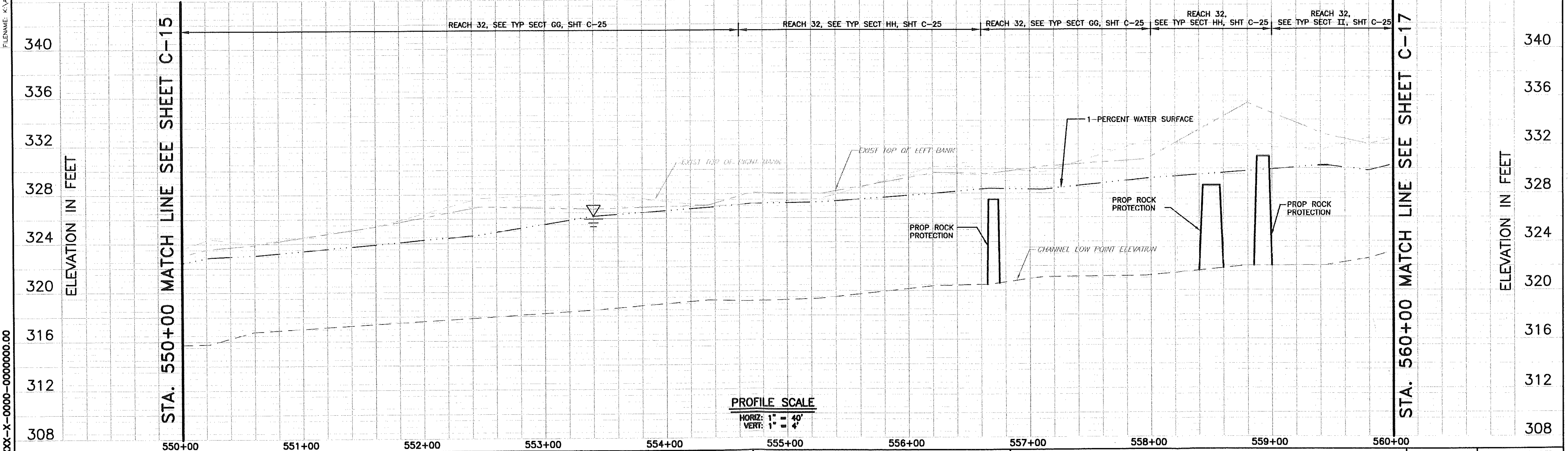


MATCH LINE SEE SHEET C-15
STA. 550+00
MATCH LINE SEE SHEET C-17
STA. 560+00
CALABAZAS CREEK
CONTROL LINE
FLOW
550+00
551+00
552+00
553+00
554+00
555+00
556+00
557+00
558+00
559+00
560+00
EXIST R/W
EXIST SACKED CONCRETE
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST ROCKS
PROP ROCK PROTECTION
ARROYO DE ARGUELLO
ROBERT CHEE & SHIU-YI ALICE CHU APN 366-20-011
FRANK R & GWENDOLINE B MASON APN 366-20-012
DOUGLAS & BETTINA CASE APN 366-20-013
NED H & KIMIKO OHARA APN 366-20-014
BETTE R & OTTO M CRAWFORD APN 366-20-015
WILLIAM KELLER APN 366-20-016
DANIEL L & NANCY A CHEADLE APN 366-20-017
ROBERT B & CATHERINE E SMITH APN 366-20-018
BRACKLEIN CONRAD H APN 366-20-019
DAVID FERNANDEZ 366-28-010
WILLIAM P & JAN H GEORGE APN 366-28-009
RAJA & CHARU RAJARAMAN APN 366-28-008
CAROL J & ROBERT A BOWMAN APN 366-28-007
HUNG Q & LEANNA NGUYEN APN 366-28-006
ANTHONY J STOLZ & JUNE L WHELAN-STOLZ APN 366-28-005
BARBARA B MANDAL APN 366-28-004
HENRIETTA D & SERGIO F MENDES APN 366-28-003
THOMPSON APN 366-28-002
EDWARD G & NANCY H AXELSEN APN 366-28-001

PLAN
SCALE 1" = 40'



PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1100 CFS, 10% FLOWRATE 650 CFS.

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
R. AGREDA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 59728
CIVIL
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

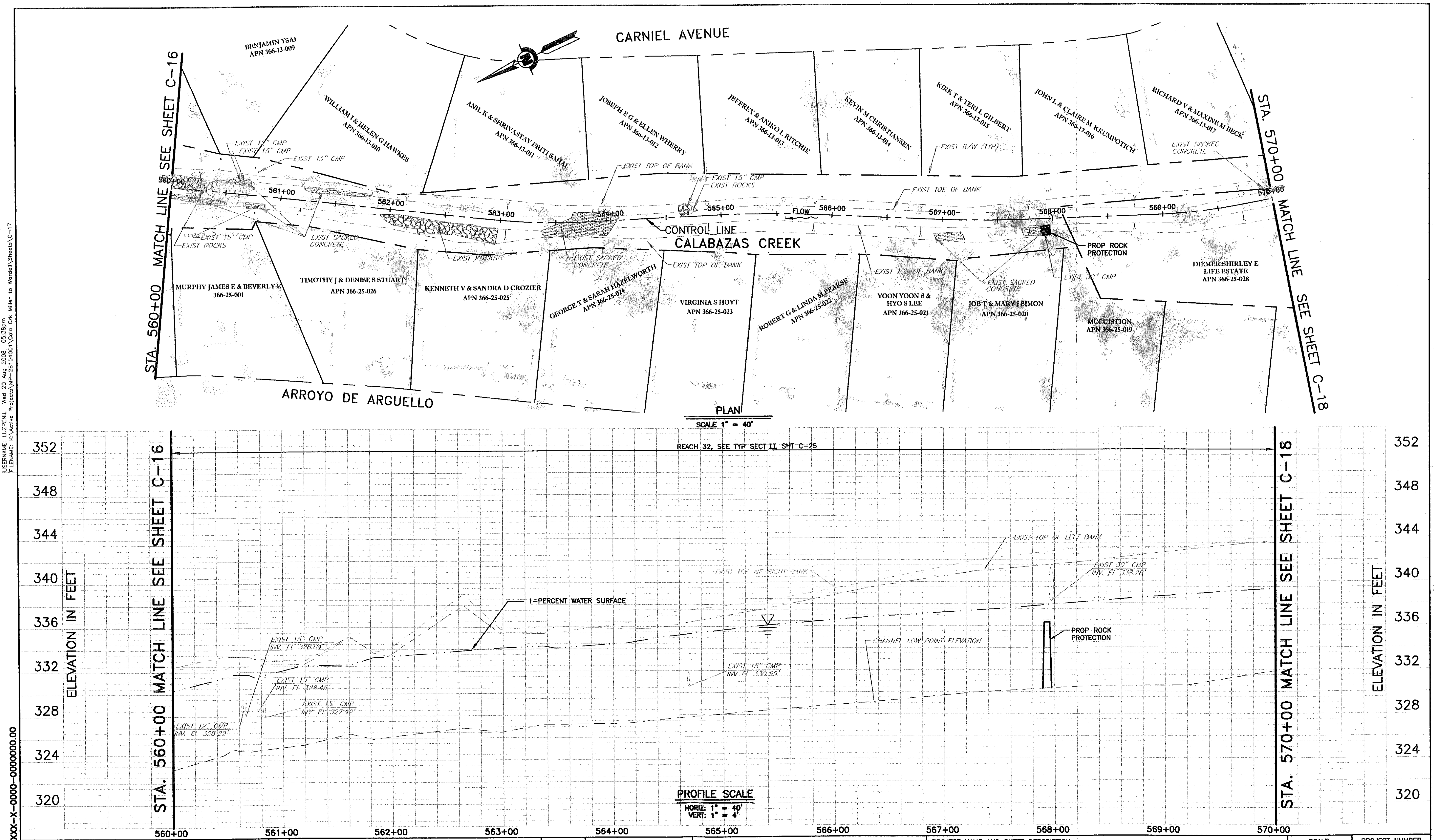
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 550+00 TO STA 560+00

SCALE
AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C-16
PAGE NUMBER:
19 OF 30

DOCUMENT NUMBER: XXXX-X-0000-000000.00


CARNIEL AVENUE
BENJAMIN TSAI APN 366-13-009
WILLIAM I & HELEN G HAWKES APN 366-13-010
ANIL K & SHRIVASTAV PRITI SAHAI APN 366-13-011
JOSEPH E G & ELLEN WHERRY APN 366-13-012
JEFFREY & ANIKO L RITCHIE APN 366-13-013
KEVIN M CHRISTIANSEN APN 366-13-014
KIRK T & TERI L GILBERT APN 366-13-015
JOHN L & CLAIRE M KRUMPOTICH APN 366-13-016
RICHARD V & MAXINE M BECK APN 366-13-017
EXIST 12" CMP
EXIST 15" CMP
EXIST 15" CMP
EXIST TOP OF BANK
EXIST 15" CMP
EXIST ROCKS
EXIST R/W (TYP)
EXIST TOE OF BANK
EXIST SACKED CONCRETE
560+00
561+00
562+00
563+00
564+00
565+00
566+00
567+00
568+00
569+00
570+00
FLOW
CONTROL LINE
CALABAZAS CREEK
EXIST 15" CMP
EXIST ROCKS
EXIST SACKED CONCRETE
EXIST ROCKS
EXIST SACKED CONCRETE
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST SACKED CONCRETE
PROP ROCK PROTECTION
EXIST 30" CMP
MURPHY JAMES E & BEVERLY E 366-25-001
TIMOTHY J & DENISE S STUART APN 366-25-026
KENNETH V & SANDRA D CROZIER APN 366-25-025
GEORGE T & SARAH HAZELWORTH APN 366-25-024
VIRGINIA S HOYT APN 366-25-023
ROBERT G & LINDA M PEARSE APN 366-25-022
YOON YOON S & HYO S LEE APN 366-25-021
JOB T & MARY J SIMON APN 366-25-020
MCCUISTION APN 366-25-019
DIEMER SHIRLEY E LIFE ESTATE APN 366-25-028
STA. 560+00 MATCH LINE SEE SHEET C-16
STA. 570+00 MATCH LINE SEE SHEET C-18
ARROYO DE ARGUELLO
PLAN
SCALE 1" = 40'
REACH 32, SEE TYP SECT II, SHT C-25
352
348
344
340
336
332
328
324
320
ELEVATION IN FEET
EXIST TOP OF LEFT BANK
EXIST TOP OF RIGHT BANK
EXIST 30" CMP INV. EL 338.26'
1-PERCENT WATER SURFACE
PROP ROCK PROTECTION
CHANNEL LOW POINT ELEVATION
EXIST 15" CMP INV. EL 328.04'
EXIST 15" CMP INV. EL 330.59'
EXIST 15" CMP INV. EL 328.45'
EXIST 15" CMP INV. EL 327.92'
EXIST 12" CMP INV. EL 328.22'
PROFILE SCALE
HORIZ: 1" = 40'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
	PLANNING STUDY REPORT 08-04-08			1. 1% FLOWRATE 1100 CFS, 10% FLOWRATE 650 CFS.

DATE AUG 08
DESIGN P. GHARIB
DRAWN R. AGREDA
CHECKED L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 36737
Exp. 12/31/
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

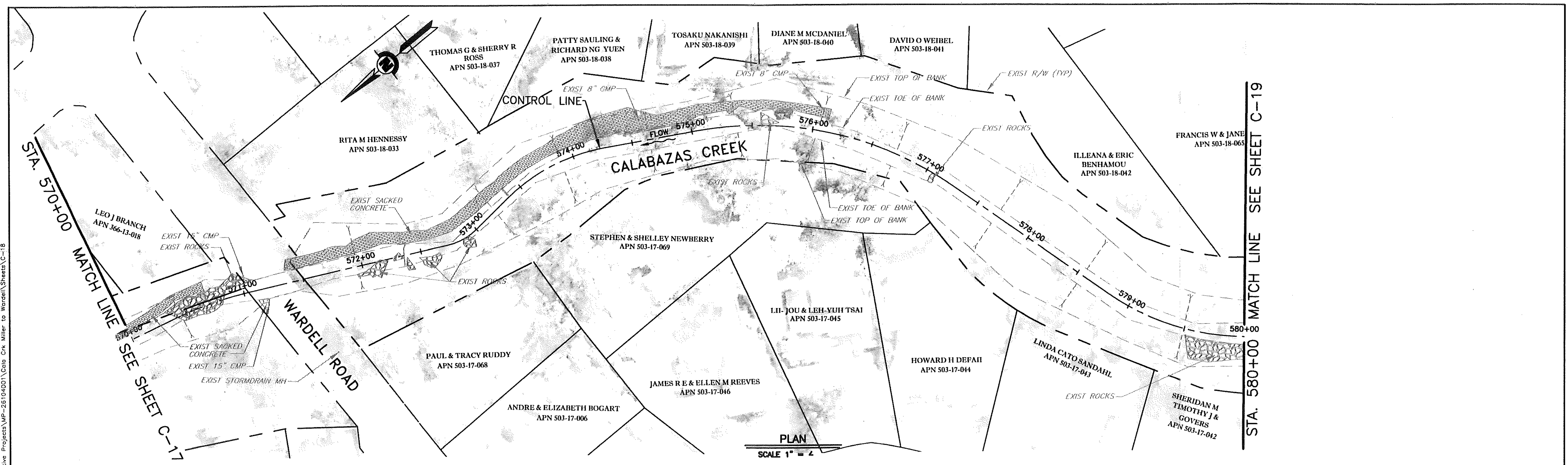
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 560+00 TO STA 570+00

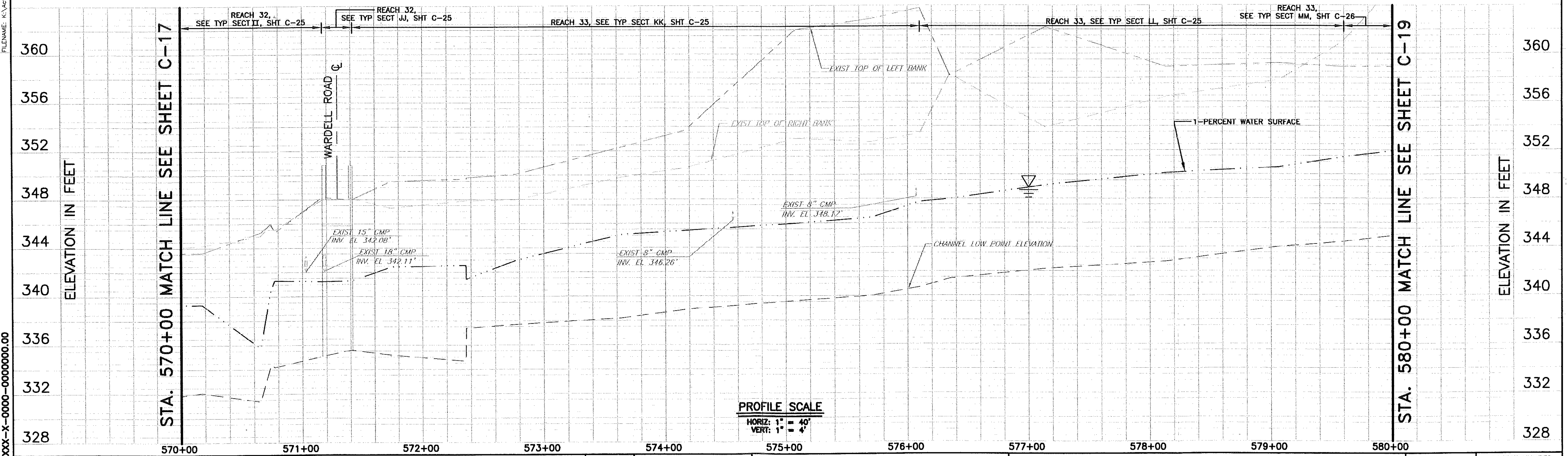
SCALE
AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C-17
PAGE NUMBER:
20 OF 30

DOCUMENT NUMBER: XXXX-X-0000-000000.00



THOMAS G & SHERRY R ROSS APN 503-18-037
PATTY SAULING & RICHARD NG YUEN APN 503-18-038
TOSAKU NAKANISHI APN 503-18-039
DIANE M MCDANIEL APN 503-18-040
DAVID O WEIBEL APN 503-18-041
FRANCIS W & JANE APN 503-18-065
ILLEANA & ERIC BENHAMOU APN 503-18-042
RITA M HENNESSY APN 503-18-033
LEO J BRANCH APN 366-13-018
STEPHEN & SHELLEY NEWBERRY APN 503-17-069
LII- JOU & LEH-YUH TSAI APN 503-17-045
HOWARD H DEFAH APN 503-17-044
LINDA CATO SANDAHL APN 503-17-043
SHERIDAN M TIMOTHY J & GOVERS APN 503-17-042
PAUL & TRACY RUDDY APN 503-17-068
JAMES R E & ELLEN M REEVES APN 503-17-046
ANDRE & ELIZABETH BOGART APN 503-17-006
CALABAZAS CREEK
WARDELL ROAD
CONTROL LINE
FLOW
EXIST 8" CMP
EXIST TOP OF BANK
EXIST TOE OF BANK
EXIST R/W (TYP)
EXIST ROCKS
EXIST SACKED CONCRETE
EXIST 15" CMP
EXIST STORMDRAIN MH
570+00
571+00
572+00
573+00
574+00
575+00
576+00
577+00
578+00
579+00
580+00
STA. 570+00 MATCH LINE SEE SHEET C-17
STA. 580+00 MATCH LINE SEE SHEET C-19
PLAN
SCALE 1" = 4



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DOCUMENT NUMBER: XXXX-X-0000-0000000.00

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1100 CFS, 10% FLOWRATE 650 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	R. AGREDA
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE STA 570+00 TO STA 580+00

SCALE
AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-18

PAGE NUMBER:
21 OF 30

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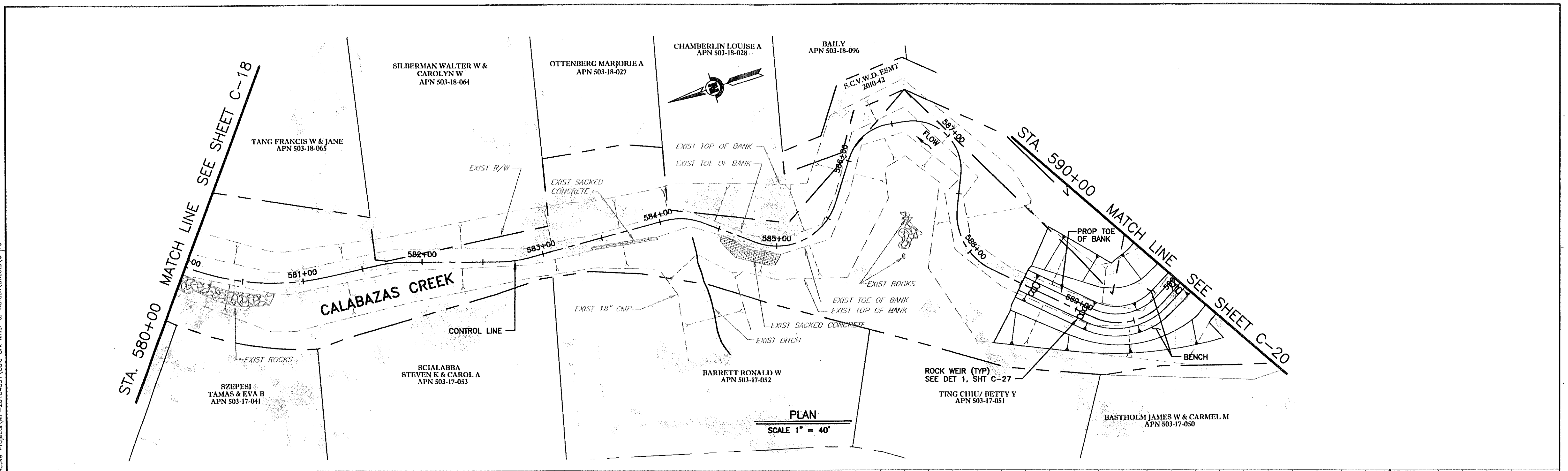

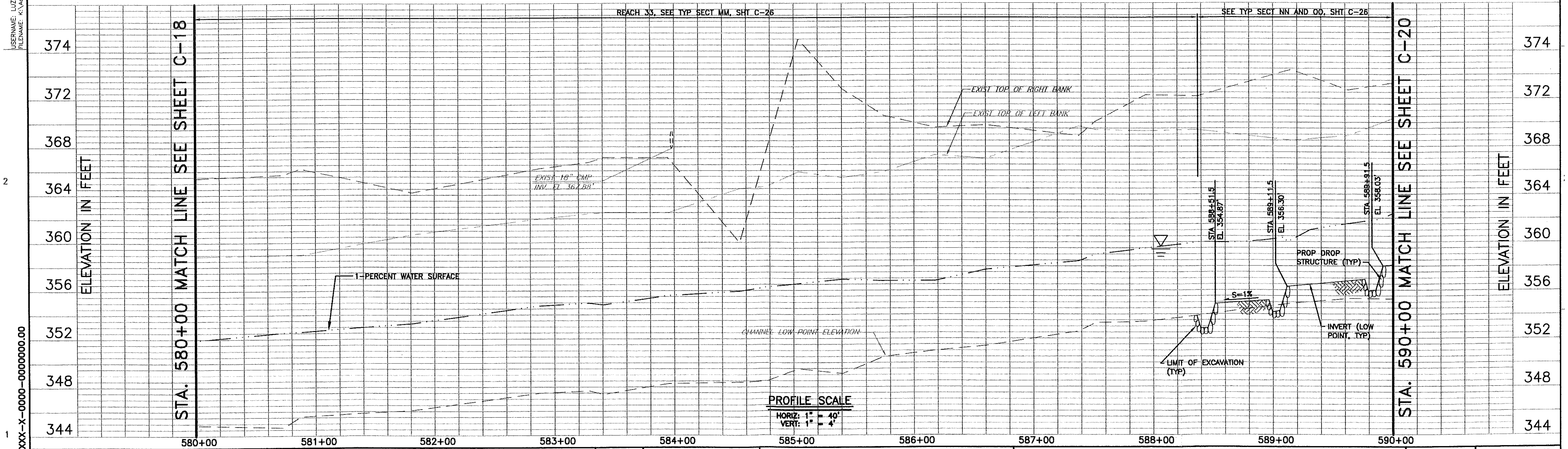

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1100 CFS, 10% FLOWRATE 650 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	M. SUTO
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 59727
Exp. 12/31/09

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 580+00 TO 590+00

SCALE: AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26104001

SHEET CODE: C-19

PAGE NUMBER: 22 OF 30

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

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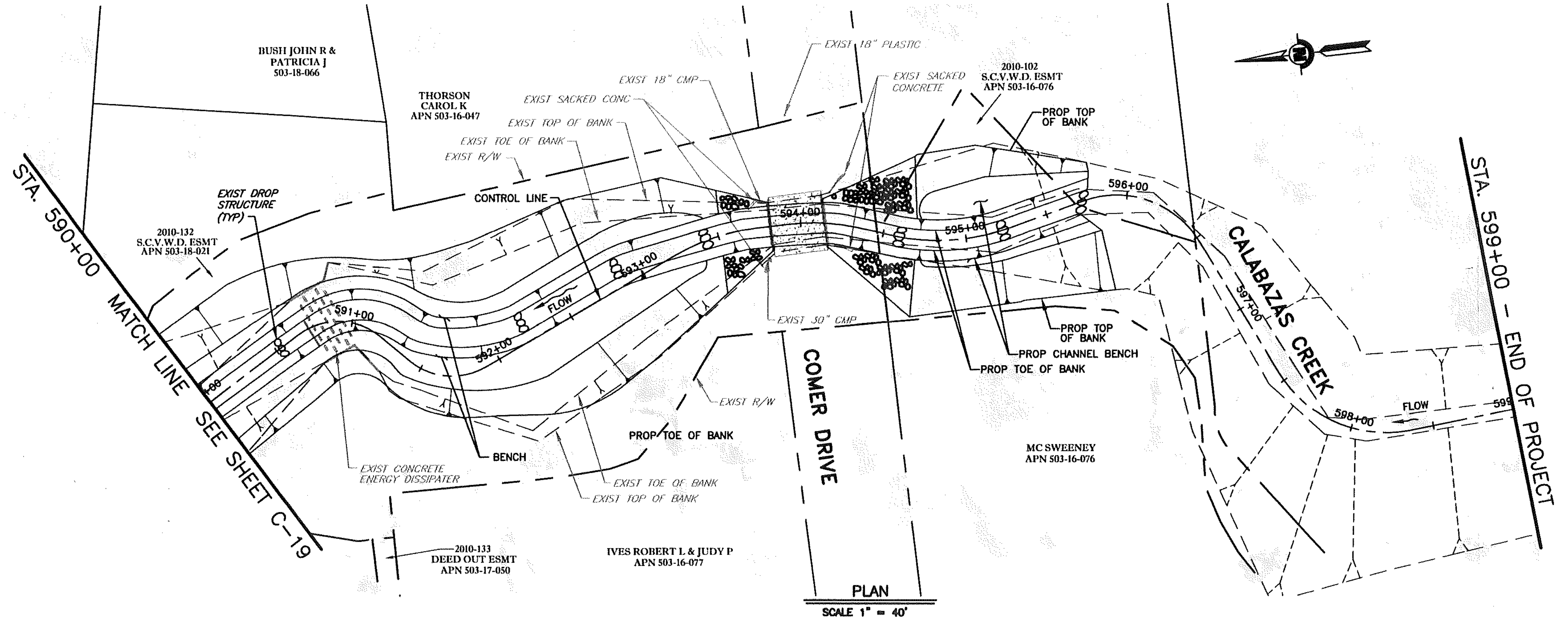
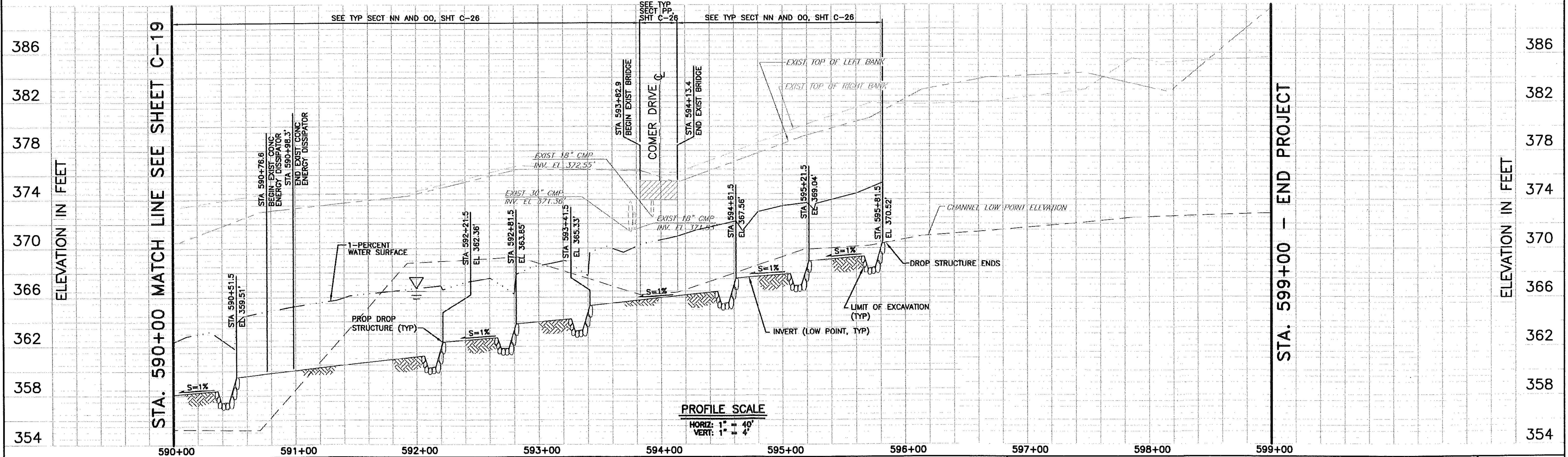




REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. 1% FLOWRATE 1100 CFS, 10% FLOWRATE 650 CFS.

DATE	AUG 08
DESIGN	P. GHARIB
DRAWN	M. SUTO
CHECKED	L. WEESE

ENGINEERING CERTIFICATION

LEROY A. WEESE
No. 58727
Exp 12/31/09

PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

PLAN AND PROFILE
STA 590+00 TO STA 599+00

SCALE
AS SHOWN

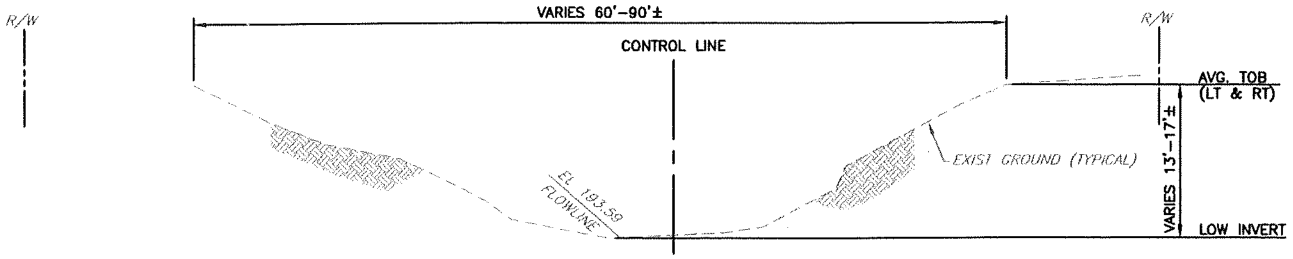
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001

SHEET CODE:
C-20

PAGE NUMBER:
23 OF 30

DOCUMENT NUMBER: XXXX-X-0000-000000.00



TYPICAL SECTION A / C-1 STA 403+39.3 TO STA 409+25
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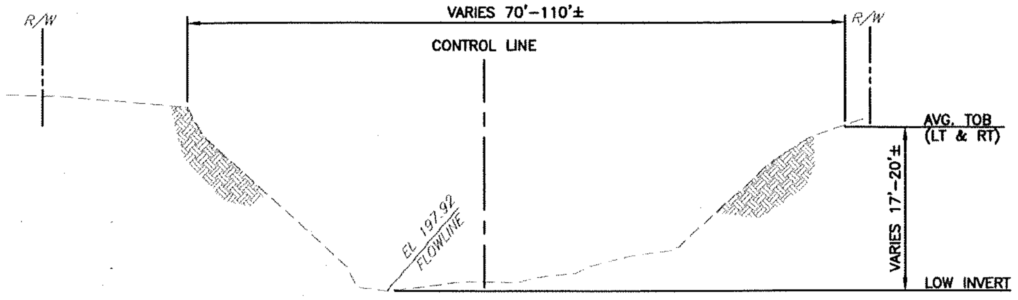

TYPICAL SECTION B / C-1 C-2 STA 409+80 TO STA 420+00
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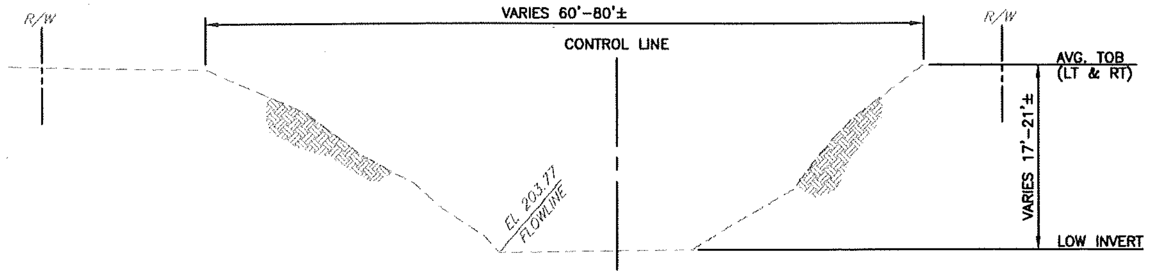

TYPICAL SECTION C / C-3 STA 420+00 TO STA 430+00
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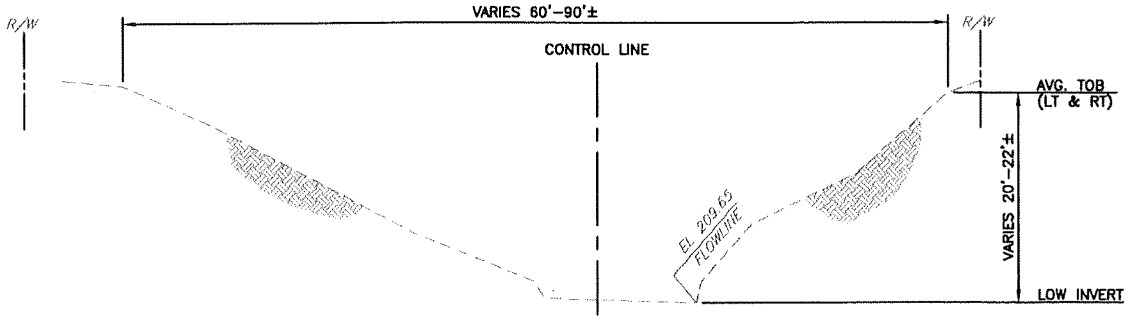

TYPICAL SECTION D / C-4 STA 430+00 TO STA 440+00
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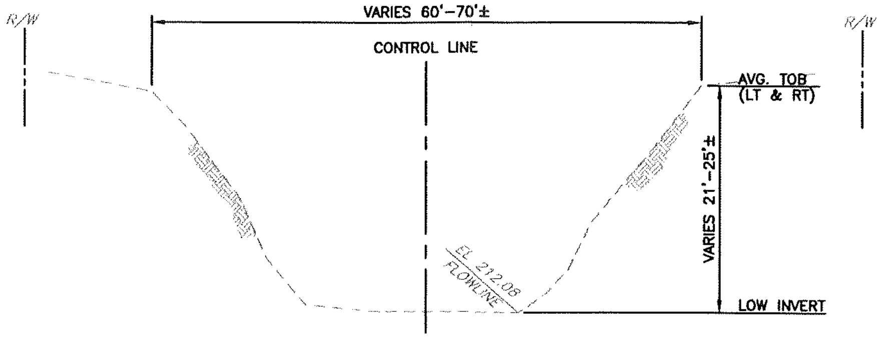

TYPICAL SECTION E / C-5 STA 440+00 TO STA 444+30
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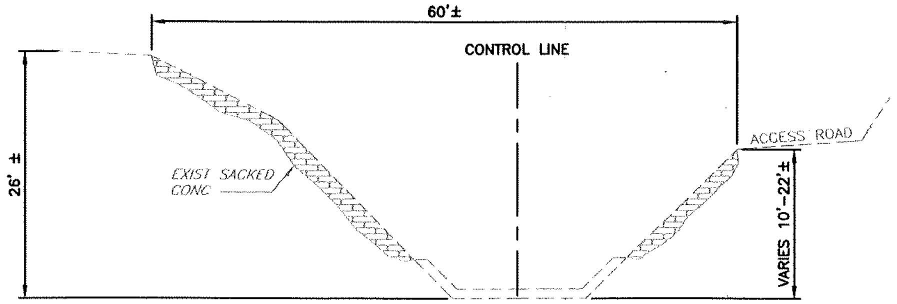

TYPICAL SECTION F / C-5 STA 445+75 TO STA 446+35 SCOUR POOL AREA
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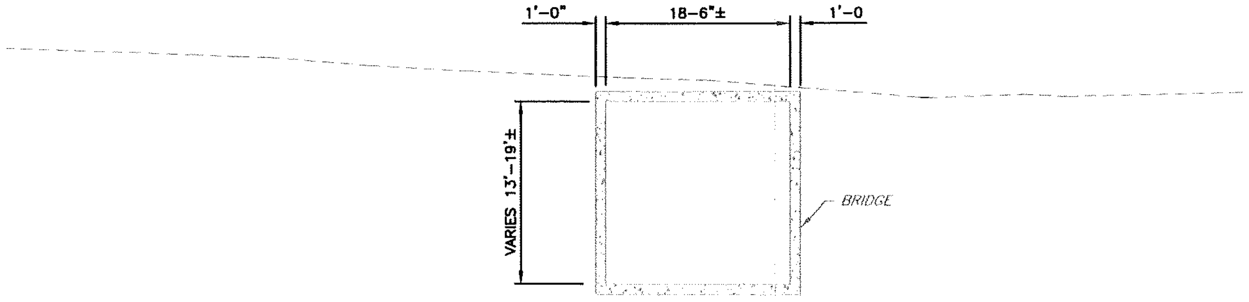


TYPICAL SECTION G / C-5 BOLLINGER BRIDGE
N.T.S.

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
	PLANNING STUDY REPORT 08-04-08			

DATE: AUG 08
DESIGN: P. GHARIB
DRAWN: J. CORDOVA
CHECKED: L. WEESE

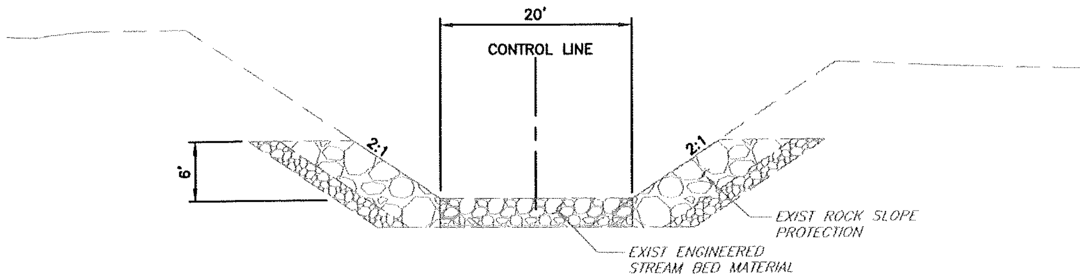
ENGINEERING CERTIFICATION
LEROY A. WEESE
PROJECT ENGINEER DATE

Santa Clara Valley Water District

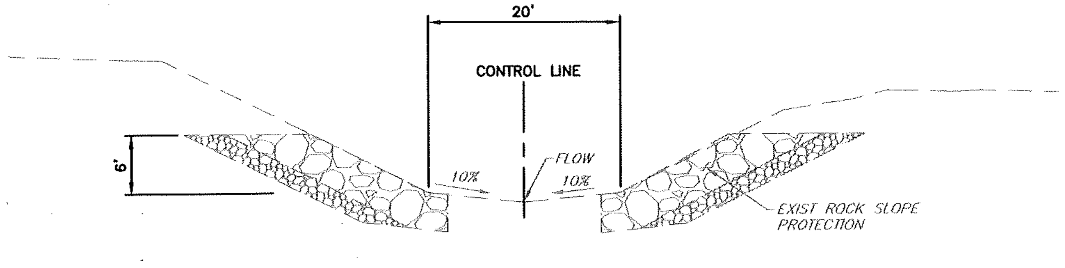
PROJECT NAME AND SHEET DESCRIPTION:
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD
TYPICAL CROSS SECTION

SCALE: AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26104001
SHEET CODE: C-21
PAGE NUMBER: 24 OF 30


20'
CONTROL LINE
6'
2:1
2:1
EXIST ROCK SLOPE PROTECTION
EXIST ENGINEERED STREAM BED MATERIAL

TYPICAL SECTION H / C-5 **STA 447+65 TO STA 448+15**
N.T.S.



TYPICAL SECTION I / C-5 **STA 448+25 TO STA 449+05**
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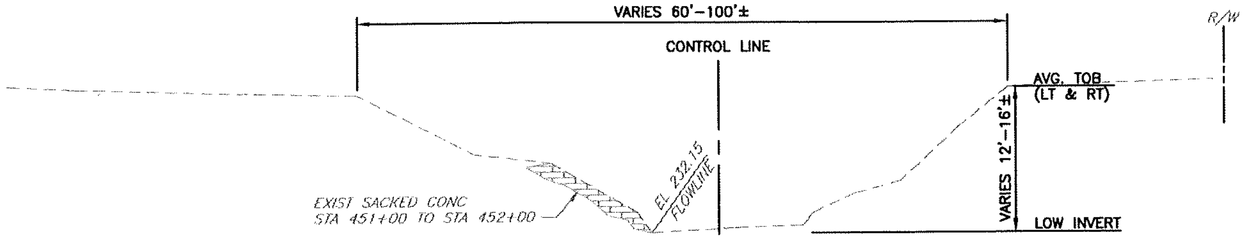

TYPICAL SECTION J / C-6 **STA 450+00 TO STA 460+00**
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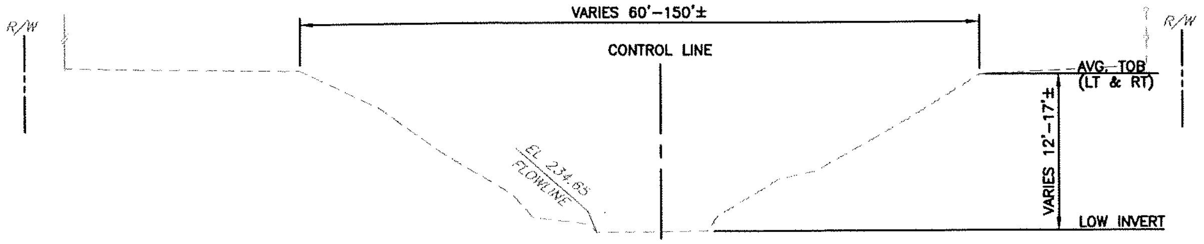

TYPICAL SECTION K / C-7 **STA 460+00 TO STA 470+00**
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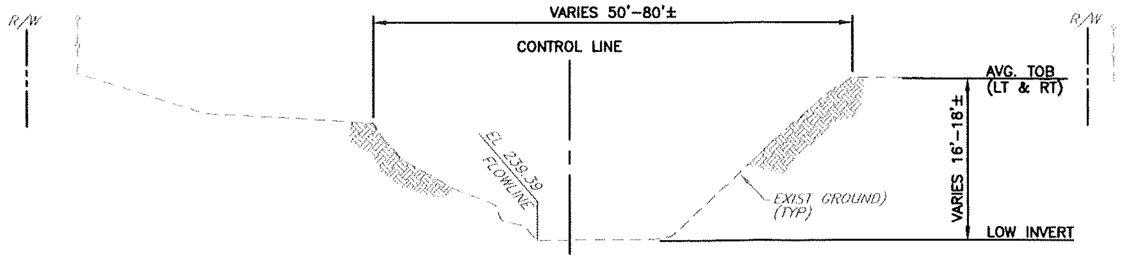

TYPICAL SECTION L / C-8 **STA 470+00 TO STA 475+00**
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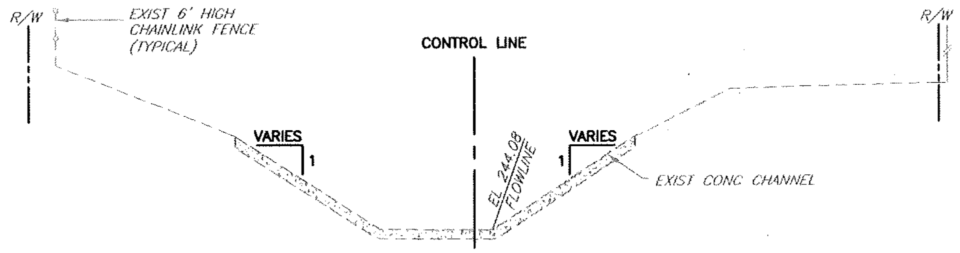
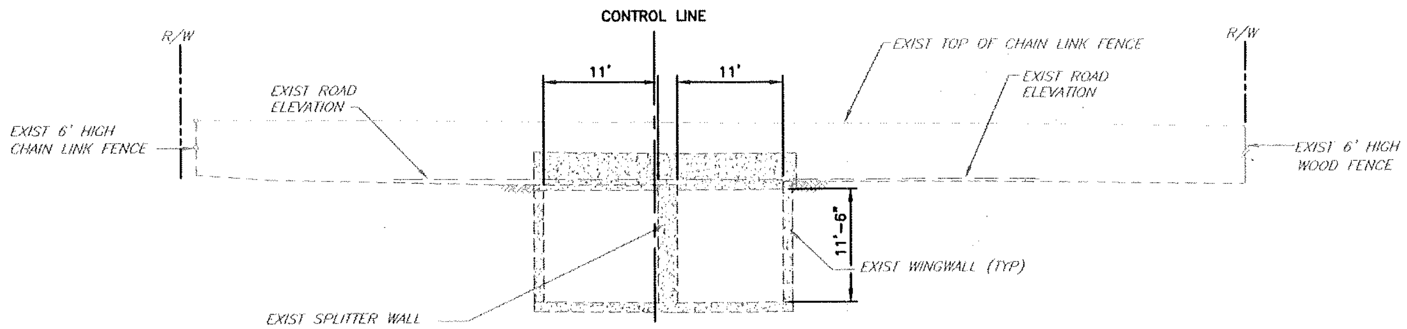
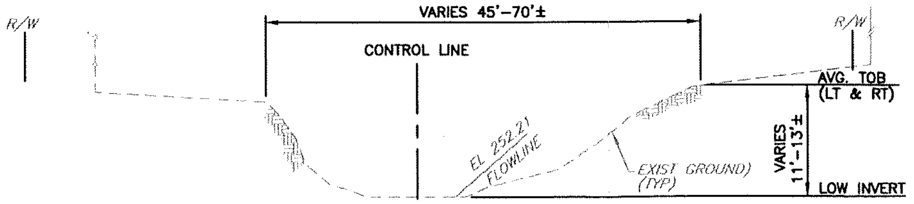


TYPICAL SECTION M / C-8 **STA 476+81.3 TO STA 477+65, STA 478+29 TO STA 478+74 WINGWALL**
N.T.S.



TYPICAL SECTION N / C-8 **BLANEY AVENUE-DOWNSTREAM**
N.T.S.



TYPICAL SECTION O / C-8 **STA 478+74 TO STA 490+50**
C-9, C-10
N.T.S.

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
	PLANNING STUDY REPORT 08-04-08			

DATE
AUG 08
DESIGN
P. CHARIB
DRAWN
J. CORDOVA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 56727
Exp. 12/31/
PROJECT ENGINEER DATE

Santa Clara Valley Water District

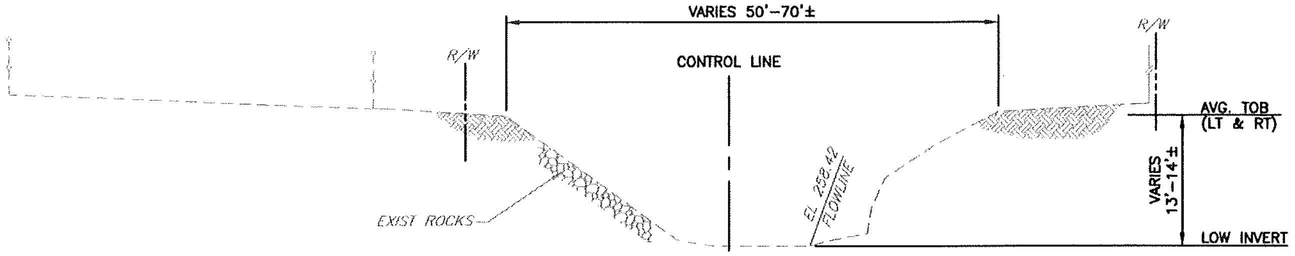
PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

TYPICAL CROSS SECTIONS

SCALE
AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C-22
PAGE NUMBER:
25 OF 30



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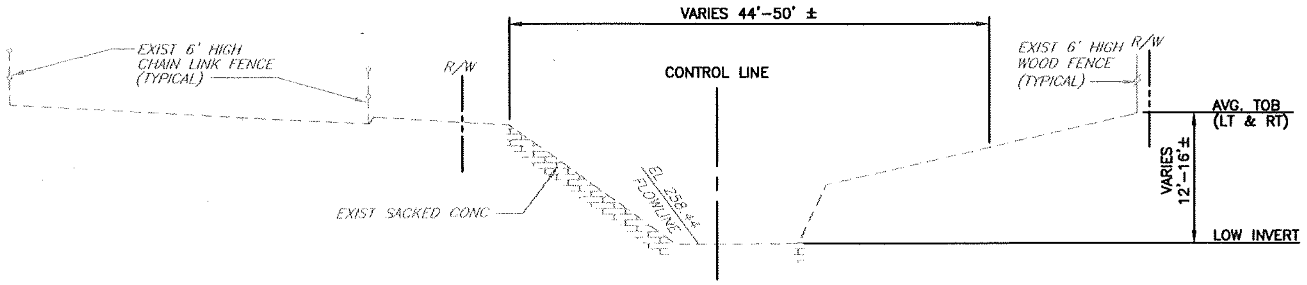

TYPICAL SECTION (Q / C–10) STA 491+80 TO STA 492+40

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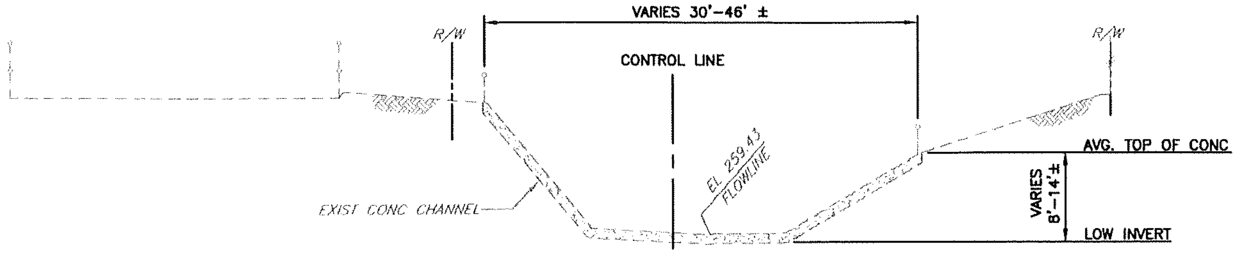
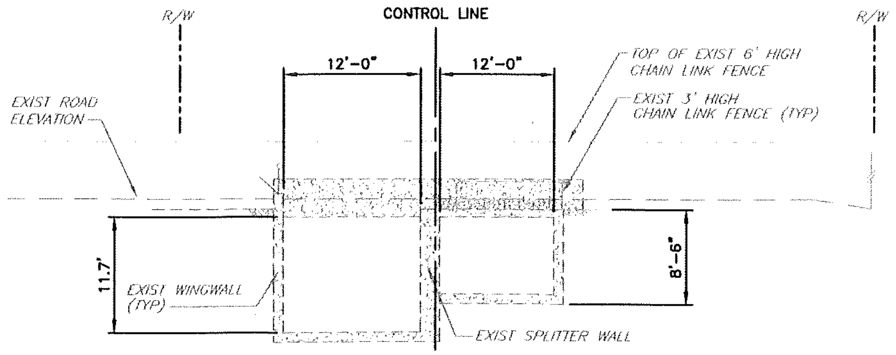


TYPICAL SECTION (R / C–10)

STA 492+40 TO STA 492+90

STA 493+90 TO STA 494+44

N.T.S.



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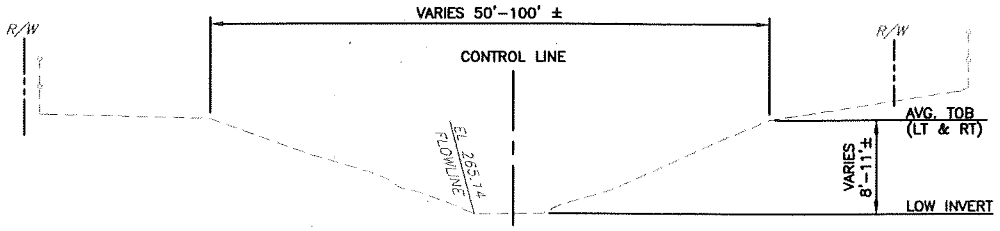
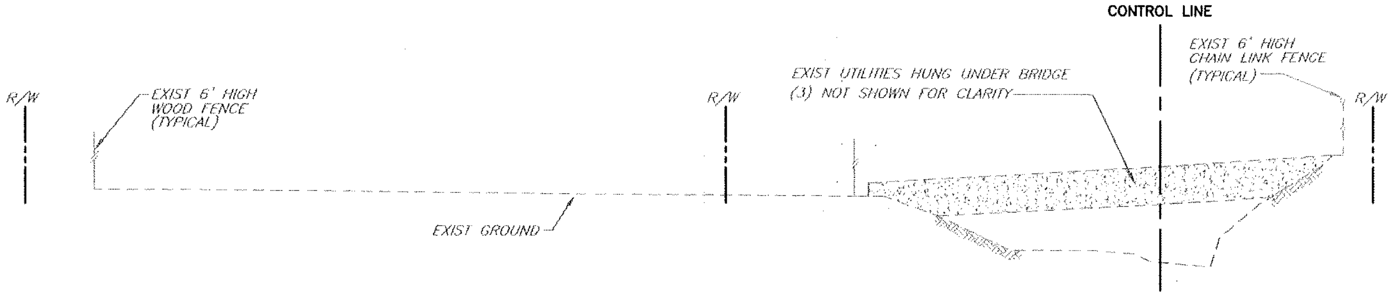


TYPICAL SECTION (T / C–10) STA 494+44 TO STA 500+00

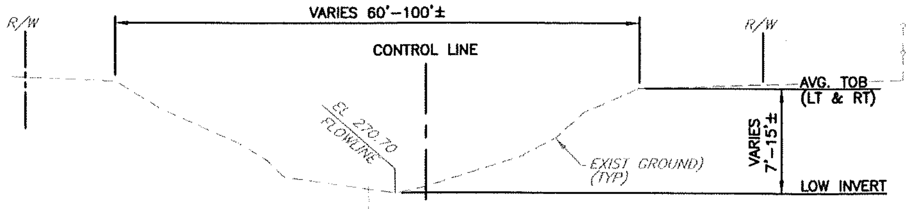
N.T.S.



TYPICAL SECTION (U / C–11) STA 501+36.1 TO 501+42.7

FOOTBRIDGE

N.T.S.



TYPICAL SECTION (V / C–11) STA 500+00 TO STA 506+90

N.T.S.

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
	PLANNING STUDY REPORT 08-04-08			

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
J. CORDOVA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

TYPICAL CROSS SECTION

SCALE
AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C–23
PAGE NUMBER:
26 OF 30

USERNAME: LUZPENIL Wed 20 Aug 2008 05:24pm
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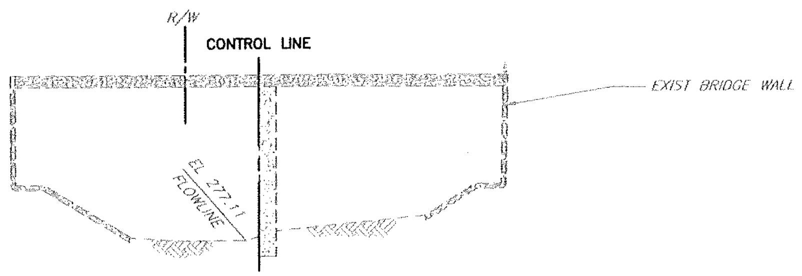

TYPICAL SECTION W C-11 C-12 STATE ROUTE 85
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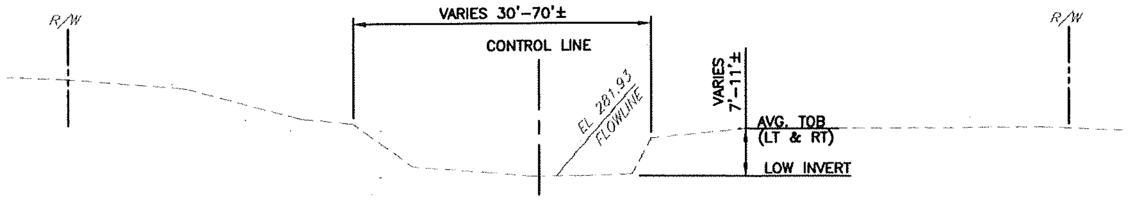

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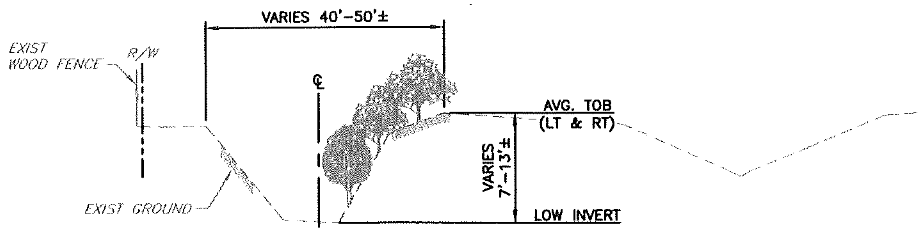

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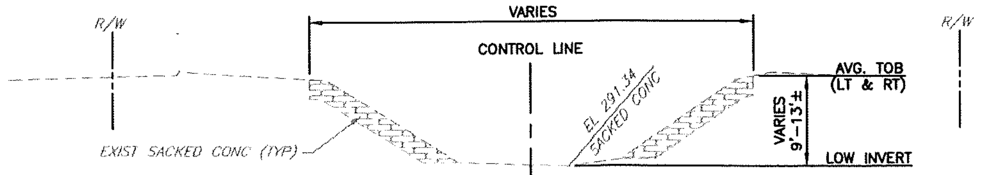

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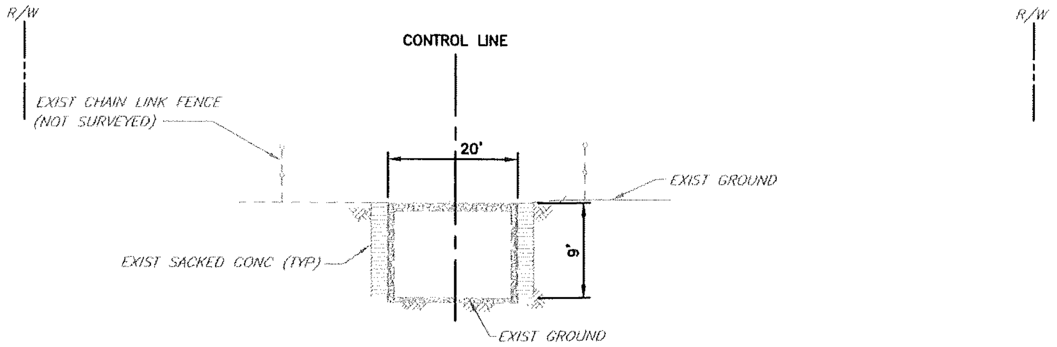

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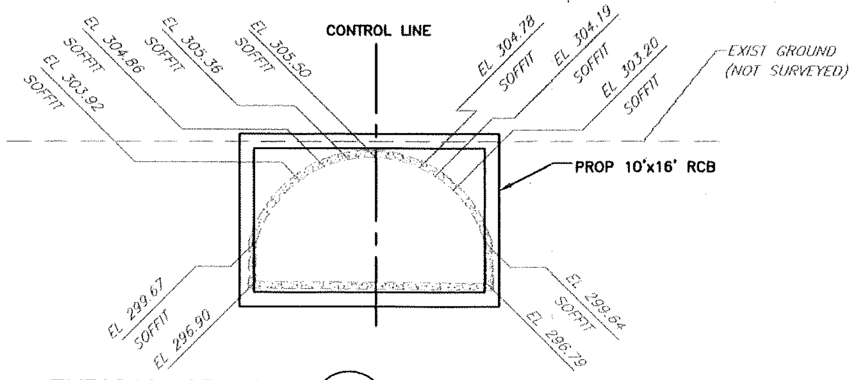

TYPICAL SECTION BB C-14 STA 531+22 TO 531+94
SARATOGA-SUNNYVALE RD.
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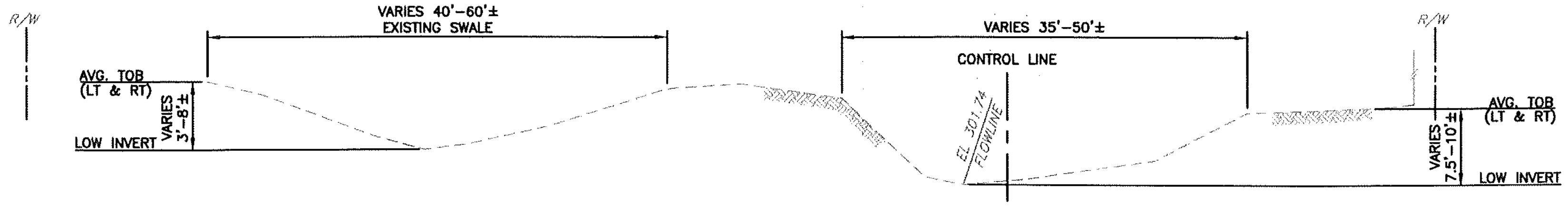

TYPICAL SECTION CC C-14 STA 532+00 TO STA 540+00
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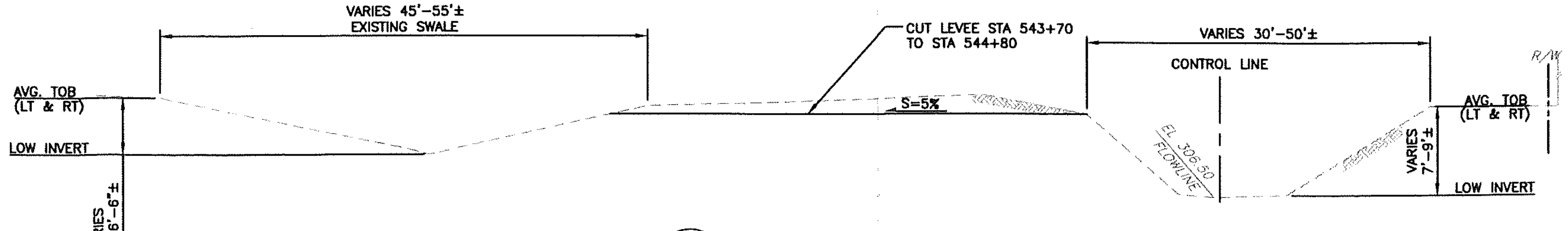

TYPICAL SECTION DD C-15 STA 540+00 TO STA 547+00
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DOCUMENT NUMBER: XXXX-X-0000-0000000.00

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
	PLANNING STUDY REPORT 08-04-08			

DATE AUG 08
DESIGN P. GHARIB
DRAWN J. CORDOVA
CHECKED L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE No. 50727 Exp. 12/31/09
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

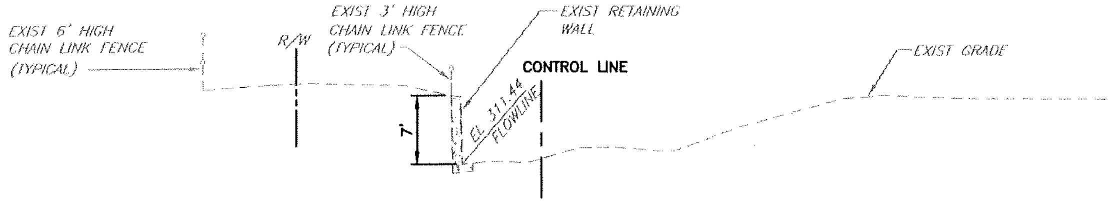
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

TYPICAL CROSS SECTIONS

SCALE
AS SHOWN

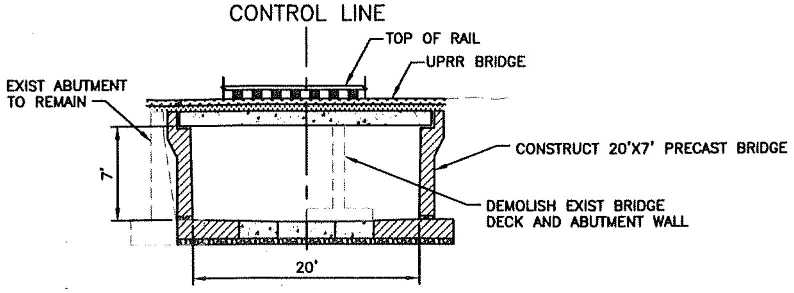
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER
26104001
SHEET CODE:
C-24
PAGE NUMBER:
27 OF 30


EXIST 6' HIGH CHAIN LINK FENCE (TYPICAL)
R/W
EXIST 3' HIGH CHAIN LINK FENCE (TYPICAL)
EXIST RETAINING WALL
CONTROL LINE
EXIST GRADE
7'
EL 311.44 FLOWLINE

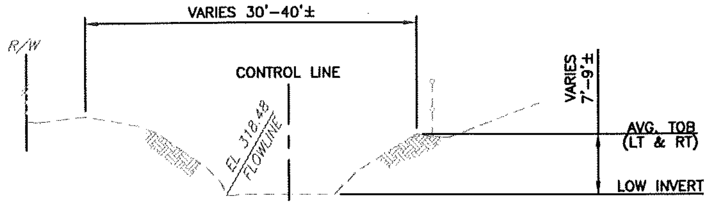
TYPICAL SECTION EE / C-15 STA 547+00 TO STA 548+00

N.T.S.


CONTROL LINE
TOP OF RAIL
UPRR BRIDGE
EXIST ABUTMENT TO REMAIN
CONSTRUCT 20'X7' PRECAST BRIDGE
DEMOLISH EXIST BRIDGE DECK AND ABUTMENT WALL
7'
20'

TYPICAL SECTION FF / C-15 STA 548+50
UPRR BRIDGE TYPICAL SECTION

N.T.S.



TYPICAL SECTION GG / C-15 / C-16
STA 549+00 TO STA 554+60
STA 556+60 TO STA 558+00

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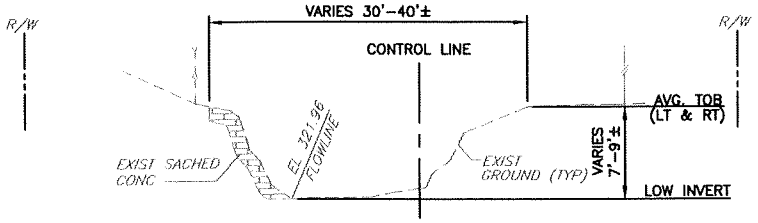

TYPICAL SECTION HH / C-16
STA 554+60 TO STA 556+60 AND
STA 558+00 TO STA 559+00

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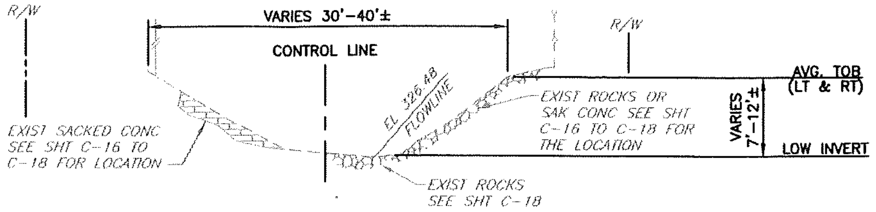

TYPICAL SECTION II / C-16 / C-17, C-18 STA 559+00 TO STA 570+00

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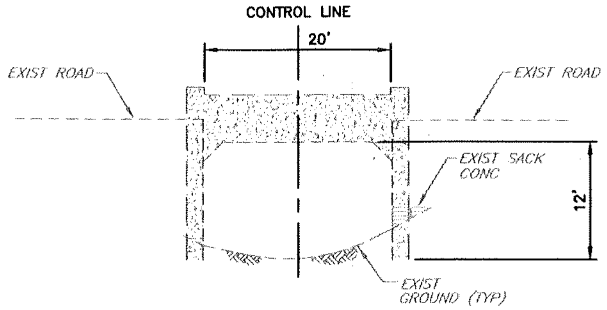

TYPICAL SECTION JJ / C-18 WARDELL ROAD

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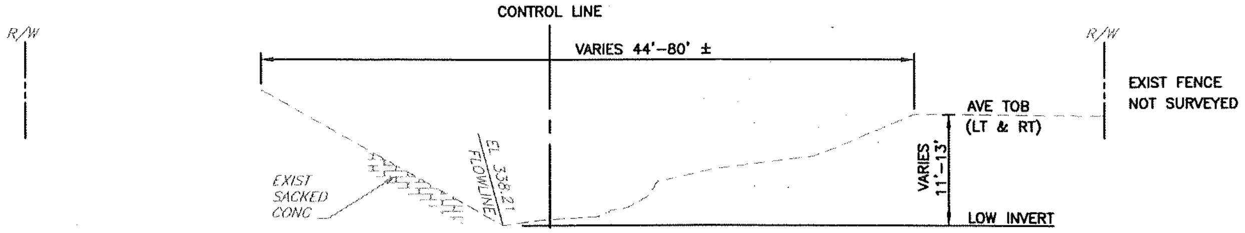

TYPICAL SECTION KK / C-18 STA 571+41 TO STA 576+10

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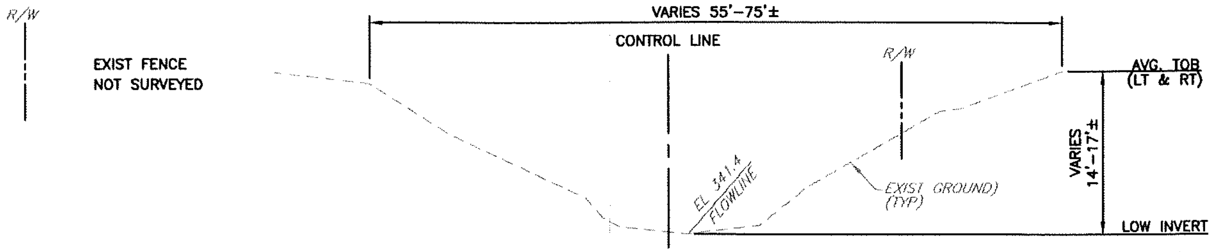

TYPICAL SECTION LL / C-18 STA 576+10 TO STA 579+60

N.T.S.

REV	DESCRIPTION	DATE	APPR.	REFERENCE INFORMATION AND NOTES
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CHECKED L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. [illegible]
Exp. 12/31/[illegible]
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:
CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD
TYPICAL CROSS SECTIONS

SCALE AS SHOWN
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 26104001
SHEET CODE: C-25
PAGE NUMBER: 28 OF 30

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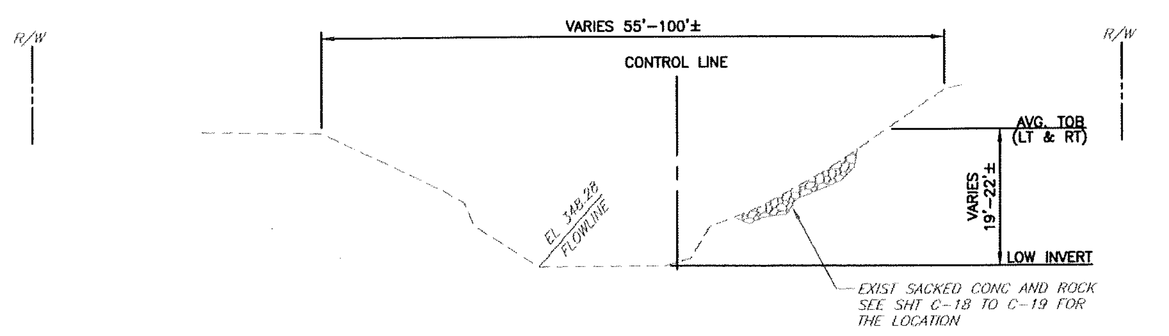

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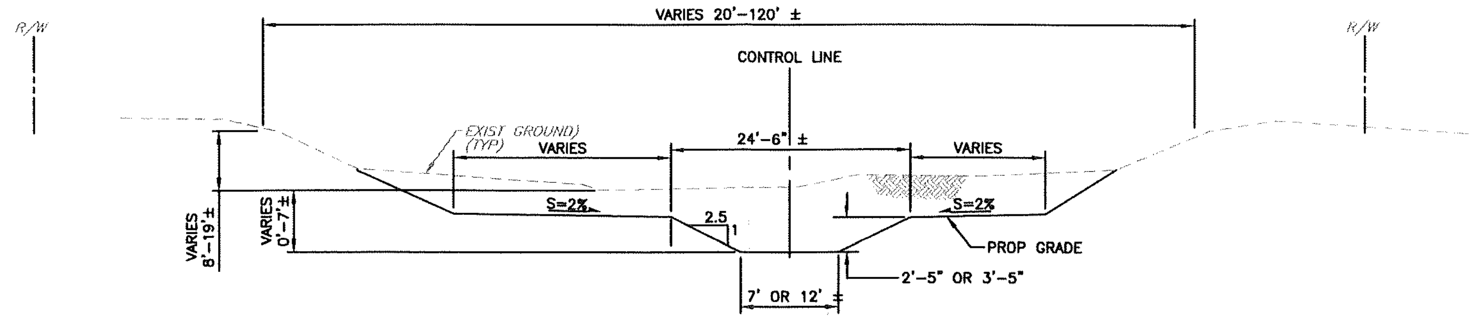

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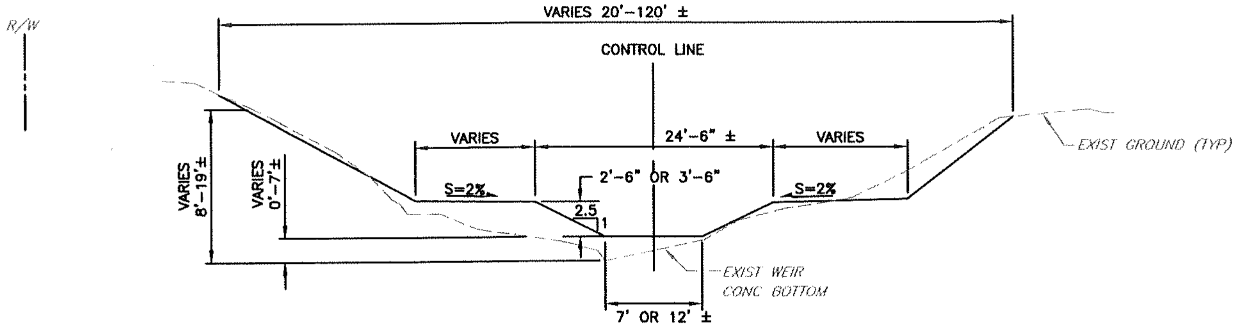

TYPICAL SECTION NN C-19 C-20 STA 588+50 TO STA 593+30 STA 594+75 TO STA 596+00 DROP STRUCTURE (FILL)

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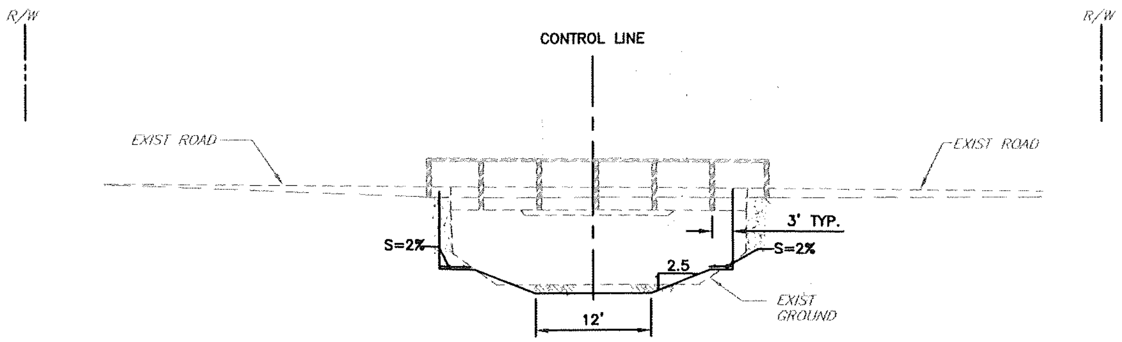

TYPICAL SECTION PP C-20 COMER DRIVE BRIDGE

N.T.S.

TYPICAL SECTION

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DATE
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J. CORDOVA
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
PROJECT ENGINEER DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

TYPICAL CROSS SECTIONS

SCALE
AS SHOWN
VERIFY SCALES
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BAR IS ONE INCH ON ORIGINAL DRAWING
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PROJECT NUMBER
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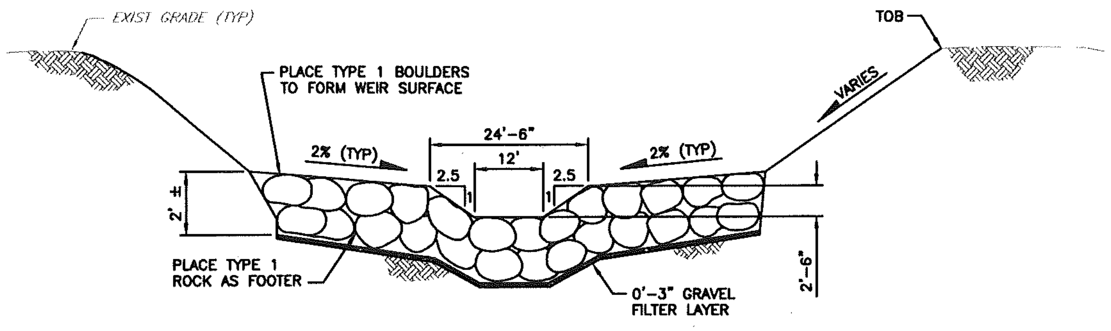
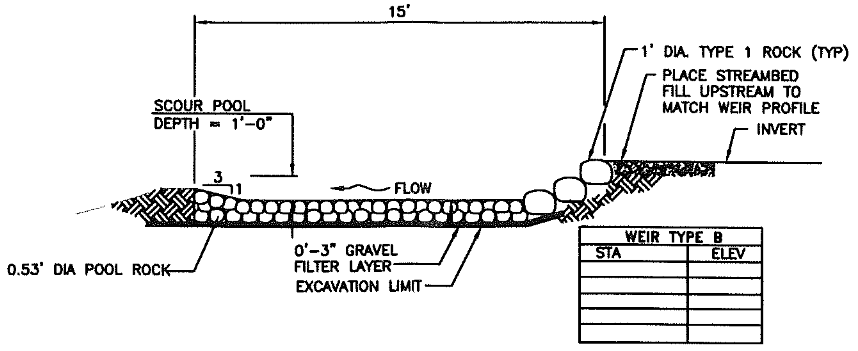
SHEET CODE:
C-26
PAGE NUMBER:
29 OF 30


EXIST GRADE (TYP)
TOB
PLACE TYPE 1 BOULDERS TO FORM WEIR SURFACE
VARIES
24'-6"
12'
2% (TYP)
2% (TYP)
2.5
1
2.5
1
2' ±
PLACE TYPE 1 ROCK AS FOOTER
0'-3" GRAVEL FILTER LAYER
2'-6"

SECTION A/– ROCK WIER TYPE B

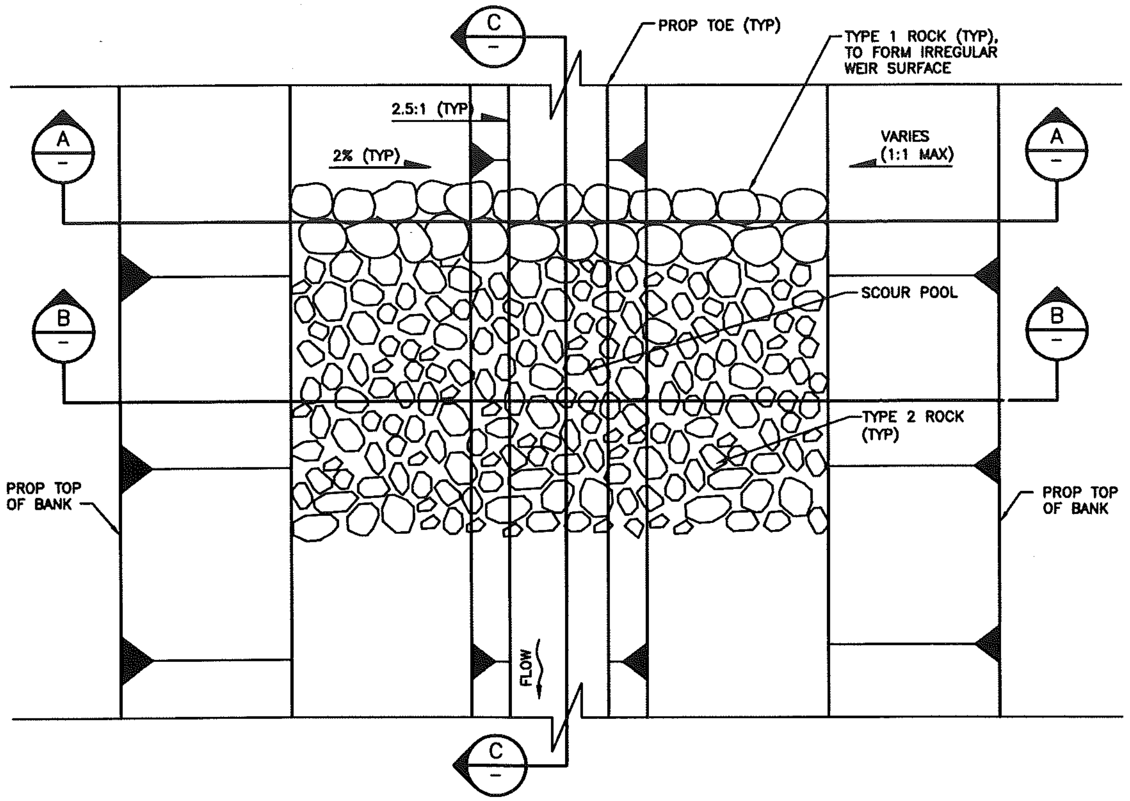
N.T.S.


15'
1' DIA. TYPE 1 ROCK (TYP)
PLACE STREAMBED FILL UPSTREAM TO MATCH WEIR PROFILE
INVERT
SCOUR POOL DEPTH = 1'-0"
3
1
FLOW
0.53' DIA POOL ROCK
0'-3" GRAVEL FILTER LAYER
EXCAVATION LIMIT

WEIR TYPE B	
STA	ELEV

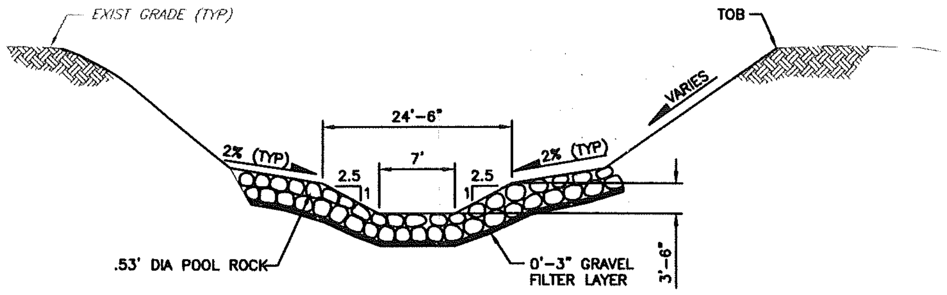
SECTION C/– ROCK WEIR TYPE B

N.T.S.



DETAIL 1/C-19 ROCK WIER – PLAN

N.T.S



SECTION B/– ROCK WEIR TYPE B AT SCOUR POOL

N.T.S.

REV	DESCRIPTION	DATE	APPR.
	PLANNING STUDY REPORT 08-04-08		

REFERENCE INFORMATION AND NOTES

1. FOUNDATION ROCK SHALL BE PLACED DOWNSTREAM OF WEIR ROCKS AND EMBEDDED D/2 BELOW TOP OF WEIR ROCK
2. BACKFILL SHALL BE COMPACTED TO MINIMUM 90% RELATIVE COMPACTION.
3. ALL ELEVATIONS AND STATIONS SHALL BE STAKED AND APPROVED BY ENGINEER BEFORE CONSTRUCTION.
4. FILL ALL INTERSTICES WITH STREAMBED FILL MATERIAL.

DATE
AUG 08
DESIGN
P. GHARIB
DRAWN
M. SUTO
CHECKED
L. WEESE

ENGINEERING CERTIFICATION
LEROY A. WEESE
No. 50727
Exp. 12/31/08
CIVIL
PROJECT ENGINEER
DATE

Santa Clara Valley Water District

PROJECT NAME AND SHEET DESCRIPTION:

CALABAZAS CREEK PROJECT
MILLER AVE TO WARDELL ROAD

ROCK WEIR DETAILS

SCALE
AS SHOWN

VERIFY SCALES
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26104001

SHEET CODE:
C-27

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A

APPENDIX A

List of Technical Terms and Acronyms

APPENDIX A
LIST OF TECHNICAL TERMS

Ad Valorem Tax: A tax based on property value.

Amortization: The process of liquidating a debt by installment payments or payment into a sinking fund; to prorate over a defined period at a specified interest rate.

Benefit Assessment: Revenues that supplement other available but limited revenues sufficiently to keep the existing flood protection system in a safe and effective condition, to perform maintenance and repair, to provide for needed new flood control construction, and in general to provide all flood control services ; to the public. The assessments are levied in proportion to benefits received, that is, on the basis of proportionate stormwater runoff from each parcel. The assessment per single family residence is uniform zonewide ($13.80 per year in FY 1990-91).

Confluence: The junction of two streams.

Cubic Foot Per Second (cfs): A rate of flow equivalent to 1 cubic foot, about 716 gallons, passing a point during 1 second (approximately 450 gallons/minute).

dBA: Decibel, a unit for measuring the volume of a sound.

Design Flow: The magnitude of streamflow that is used in design of channel modifications and structures 'across channels.

Freeboard: Vertical distance between the top of an embankment adjoining a channel and the water level in the channel- It is a factor of safety designed into a project.

Floodwaters: Those flows of water that cannot be contained within the natural stream channel.

Floodplain: A wide- gently sloping area subject to periodic flooding.

Gabion: A wire mesh rectangular basket filled with uniformly sized rocks.

Levees: Earth embankments that are constructed to contain flood flows. In this project there are existing levees (part of the existing creek) and proposed levees (part of the proposed flood control project).

One Percent (1) Flood: The flood that has a 1 percent chance of being equalled or exceeded in any one year. (See Appendix H).

Reach: A subdivision of the creek for convenience of study and reference.

Riparian: Vegetation and wildlife living within and immediately adjacent to a river, stream, or lake. In this report, riparian means the creek environment.

Rock Lining: Also called riprap, this is a measure commonly used to protect against erosion of earth banks OT creek bottoms. In this project, most rock-lined areas will also be filled with soil and revegetated.

Roughness Coefficient: Represents the frictional resistance of a surface to the flow of water; used in hydraulic computations.

Watershed: The geographical region or area, drained1 by a stream. Also referred to as a basin.

Wetlands: As used herein, areas that under normal circumstances have hydrophytic vegetation, wetland hydrology.

B

APPENDIX B

Persons to Contact for More Information

APPENDIX B
Persons to Contact for More Information

About this Report
Saeid Hosseini, Senior Project Manager
Santa Clara Valley Water District
265-2600

About Flood Insurance
Liang Lee, Hydraulics Unit Manager
Santa Clara Valley Water District
265-2600

About Environmental Considerations
Debra Caldon, Watershed Planning Unit Manager
Santa Clara Valley Water District
265-2600

About Creek Maintenance
Gary Nagaoka, Field Operations Unit Manager
Santa Clara Valley Water District
265-2600

About Land Acquisition / Dedication
Deanna Forsythe, Real Estate Unit Manager
Santa Clara Valley Water District
265-2600

About Detailed Design and Construction
Saeid Hosseini, Senior Project Manager
Liang Lee, Hydraulics Unit Manager
Santa Clara Valley Water District
265-2600

About Local Storm Drains
Dianne Mahan
City of Cupertino
408-777-3343

Ray Ho
City of San Jose
408-277-4373

City of Saratoga
408-868-1239

C

APPENDIX C
Organizations and Persons Contacted During Preparation of This Report

APPENDIX C
Organizations and Persons Contacted During Preparation of This Report

Mr. Terrel Anderson
Union Pacific Railroad (UPRR coord)
9451 Atkinson Street
Roseville, CA 95757

Mr. Al Smith
City of San Jose (BMX Park work)
Department of Public Works
200 E. Santa Clara Street
San Jose, CA 95113

Iveta Harvancik
City of Saratoga (utility info)
Public Works Department
13777 Fruitvale Avenue
Saratoga, CA 95070
(408) 868-1274

Macedonio Nunez
City of Saratoga
Public Works Department
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Carl Beckham
Cupertino Sanitary District
(408) 253-7071

Laura Wendover
AT&T
(408) 493-8770

Joe Mannina
Pacific Gas & Electric Company
DeAnza Division
(408) 725-2281

Osvaldo Flores
Pacific Gas & Electric Company
DeAnza Division
(408) 725-2098

Bill Tuttle
San Jose Water Company
(408) 279-7861

Hoan Vu
San Jose Water Company
(408) 279-7853

D

APPENDIX D
Bibliography

APPENDIX D
Bibliography

Chapter 1

Santa Clara Valley Water District's "Clean Safe Creek and Natural Flood Protection" report dated July 25, 2000.

Chapter 2

Santa Clara Valley Water District's "Calabazas Creek Planning Study (Guadalupe Slough to Miller Avenue) consisting of the combined Engineer's Report and Final Environmental Impact Report, April, 1992

Santa Clara Valley Water District's "Staff Recommended Alternative Report" which was last updated in December, 2007.

Kennedy/Jenks Consultants report entitled: "Comer Debris Basin Engineering Feasibility Study Final Report" published in April, 2002.

Santa Clara Valley Water District's "Initial Study and Mitigated Negative Declaration" for Bollinger Road, dated May, 2003

Santa Clara Valley Water District's "Calabazas Creek – Reconstruction of Bollinger Road Bridge", Engineer's Report dated December 2004.

Santa Clara Valley Water District's "Geotechnical Investigation Report, Calabazas Creek – Miller to Wardell Planning Study" dated February 19, 2008.

Chapter 3

Santa Clara Valley Water District's "Problem Definition / Refined Objectives Report" which was last updated in May, 2007

Santa Clara Valley Water District's "HEC-6T Sediment Transport Study Report" dated July, 2006

Chapter 5

Santa Clara Valley Water District's "Design Manual Open Channel Hydraulics and Sediment Transport" dated June 2007.

Santa Clara Valley Water District's "Guidance on Alternative Evaluation for Selection for Natural Flood Protection Projects", Revision 1 dated August 25, 2005.

E

APPENDIX E

Detailed Cost Estimates

COST SUMMARY
PROJECT and ENHANCEMENT COSTS
MILLER TO COMER

PROPOSAL	ITEM OF WORK	APPROX COST
Flood Protection	Alt 3E - Swale & Culvert Replacement (Saratoga-Sunnyvale Road)	$2,500,000
	Alt 4B - Bridge Replacement (UPRR)	$2,200,000
Erosion	14 erosion sites	$250,000
Channel Enhancements	Comer Dam Modification	$1,000,000
	Revegetation D/S of Prospect	$50,000
	APPROX SUM TOTAL OF ALL COSTS	$6,000,000

FLOOD PROTECTION ALTERNATIVE COST SUMMARY

8/27/2008

SITE	ALTERNATIVE		ESTIMATE COST
Site 3	Alt 3A	RCB Bypass	$5,501,600
	Alt 3B	Additional RCB	$4,922,343
		Double RCB	$7,703,891
	Alt 3C	Floodwall	$450,542
	Alt 3D	Swale Detention with Floodwalls	$1,174,226
	Alt 3E	Swale and Culvert replacement	$2,509,707
Site 4	Alt 4A	RCP bypass	$2,410,314
	Alt 4B	Bridge Replacement	$2,217,251
	Alt 4C	Floodwall	$1,132,209

Alt 3A - Underground RCB Bypass

Length = 755 feet reinforced concrete box (RCB)

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.38	Acre	$ 10,000	$ 3,800
Bypass				
Concrete volume	1398.00	C.Y.	$ 1,100	$ 1,537,800
Utility Replacement/Protection/Modification		L.S.		$ 150,000
Earth Work				
Soil excavation	8613.00	C.Y.	$ 40	$ 344,520
Soil embankment	3691.00	C.Y.	$ 40	$ 147,640
Shoring	21140.00	S.F.	$ 25	$ 528,500
Asphalt Replacement	153.80	C.Y.	$ 11	$ 1,692
Miscellaneous				
Fencing	1500.00	L.F.	$ 15	$ 22,500
Traffic Control		LS		$ 350,000
SUBTOTAL				**$ 3,086,452**
Mobilization (10%)				$ 308,645
Construction Contingencies (30%)				$ 925,936
Market Condition (10%)				$ 308,645
Escalation to midpoint (5%)				$ 154,323
TOTAL CONSTRUCTION				**$ 4,784,000**
Inspection (5%)				$ 239,200
Construction Management (10%)				$ 478,400
R/W COSTS				
TOTAL COSTS				**$ 5,501,600**

Alt 3B - Additional RCB/New Double RCB

Length = 685 feet reinforced concrete box (RCB)

ADDITIONAL RCB

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.30	Acre	$ 10,000	$ 3,000
Tunnel				
Concrete volume	1268.52	C.Y.	$ 1,100	$ 1,395,372
Earth Work				
Soil excavation	6749.00	C.Y.	$ 40	$ 269,960
Soil embankment	2283.00	C.Y.	$ 40	$ 91,320
Shoring	19180.00	S.F.	$ 25	$ 479,500
Utility Replacement/Protection/Modification		L.S.		$ 150,000
Asphalt Replacement	121.00	C.Y.	$ 11	$ 1,331
Miscellaneous				
Fencing	1400.00	L.F.	$ 15	$ 21,000
Traffic Control		L.S.		$ 350,000
SUBTOTAL				**$ 2,761,483**
Mobilization (10%)				$ 276,148
Construction Contingencies (30%)				$ 828,445
Market Condition (10%)				$ 276,148
Escalation to midpoint (5%)				$ 138,074
TOTAL CONSTRUCTION				**$ 4,280,299**
Inspection (5%)				$ 214,015
Construction Management (10%)				$ 428,030
R/W COSTS				
TOTAL COSTS				**$ 4,922,343**

or

NEW DOUBLE RCB

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.58	Acre	$ 10,000	$ 5,800
Tunnel				

Concrete volume	2537.00	C.Y.	$ 1,100	$ 2,790,700
Concrete excavation	1268.50		$ 25	$ 31,713
Earth Work				
Soil excavation	7966.30	C.Y.	$ 40	$ 318,652
Soil embankment	4566.70	C.Y.	$ 40	$ 182,668
Shoring	19180.00	S.F.	$ 25	$ 479,500
Utility Replacement/Protection/Modification		L.S.		$ 150,000
Asphalt Replacement	241.00	C.Y.	$ 11	$ 2,651
Miscellaneous				
Fencing	685.00	L.F.	$ 15	$ 10,275
Traffic Control		L.S.		$ 350,000
SUBTOTAL				**$ 4,321,959**
Mobilization (10%)				$ 432,196
Construction Contingencies (30%)				$ 1,296,588
Market Condition (10%)				$ 432,196
Escalation to midpoint (5%)				$ 216,098
TOTAL CONSTRUCTION				**$ 6,699,036**
Inspection (5%)				$ 334,952
Construction Management (10%)				$ 669,904
R/W COSTS				
TOTAL COSTS				**$ 7,703,891**

Alt 3C - Floodwall u/s Saratoga-Sunnyvale Rd

Length = 450 feet (on top of west bank)

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.09	Acre	$ 10,000	$ 930
Floodwall				
Concrete volume	183.33	C.Y.	$ 900	$ 164,997
Earth Work				
Soil excavation	150.00	C.Y.	$ 40	$ 6,000
Miscellaneous				
Fencing	450.00	L.F.	$ 15	$ 6,750
SUBTOTAL				**$ 178,677**
Mobilization (10%)				$ 17,868
Construction Contingencies (30%)				$ 53,603
Market Condition (10%)				$ 17,868
Escalation to midpoint (5%)				$ 8,934
TOTAL CONSTRUCTION				**$ 276,949**
Inspection (5%)				$ 13,847
Construction Management (10%)				$ 27,695
R/W COSTS	2641	S.F.	$ 50	**$ 132,050**
TOTAL COSTS				**$ 450,542**

Alt 3D - Swale Detention Basin u/s Saratoga-Sunnyvale Rd

Length = 1350 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	2.00	Acre	$ 10,000	$ 20,000
Earth Work				
Soil excavation	11375.00	C.Y.	$ 40	$ 455,000
Soil embankment		C.Y.		
Shoring		S.F.		
Miscellaneous				
Fencing	2700.00	L.F.	$ 15	$ 40,500
Traffic Control		L.S.		$ 3,000
SUBTOTAL				**$ 518,500**
Mobilization (10%)				$ 51,850
Construction Contingencies (30%)				$ 155,550
Market Condition (10%)				$ 51,850
Escalation to midpoint (5%)				$ 25,925
TOTAL CONSTRUCTION				**$ 803,675**
Inspection (5%)				$ 40,184
Construction Management (10%)				$ 80,368
R/W COSTS		S.F.		
TOTAL SWALE COST				**$ 924,226**

The exact length of floodwall was not computed for Alt 3D, so assume a floodwall half the length of Alt 3C for cost estimation purposes				
TOTAL FLOODWALL COST				**$ 250,000**

TOTAL ALT 3D COST				**$ 1,174,226**

Alt 3E - Swale Detention & Culvert Modification

Length = 83 feet reinforced concrete box (RCB)

TUNNEL ENTRANCE MODIFICATION

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Access, clearing & grubbing	0.04	Acre	$ 10,000	$ 440
Tunnel				
Concrete volume	166.00	C.Y.	$ 1,100	$ 182,600
Concrete excavation	130.00	C.Y.	$ 50	$ 6,500
Earth Work				
Soil excavation	580.70	C.Y.	$ 40	$ 23,228
Soil embankment	356.00	C.Y.	$ 40	$ 14,240
Shoring	2240.00	S.F.	$ 25	$ 56,000
Utility Replacement/Protection/Modification		L.S.	$ 750,000	$ 750,000
Asphalt Replacement	17.80	C.Y.	$ 40	$ 712
Miscellaneous				
Traffic Control		L.S.		$ 350,000
SUBTOTAL				**$ 1,383,720**
Mobilization (10%)				$ 138,372
Construction Contingencies (30%)				$ 415,116
Market Condition (10%)				$ 138,372
Escalation to midpoint (5%)				$ 69,186
TOTAL CONSTRUCTION				**$ 2,144,766**
Inspection (5%)				$ 107,238
Construction Management (10%)				$ 214,477
R/W COSTS				
TOTAL COSTS				**$ 2,466,481**

and

SWALE DETENTION

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Access, clearing & grubbing	0.00	Acre	$ 10,000	$ 30
Earth Work				

Soil excavation	365.00	C.Y.	$ 40	$ 14,600
Soil embankment & grading	33.00	C.Y.	$ 40	$ 1,320
Miscellaneous				
Hydroseeding		L.S.		$ 5,000
Concrete Outlet Pipe	44.00	L.F.	$ 75	$ 3,300
SUBTOTAL				**$ 24,250**
Mobilization (10%)				$ 2,425
Construction Contingencies (30%)				$ 7,275
Market Condition (10%)				$ 2,425
Escalation to midpoint (5%)				$ 1,213
TOTAL CONSTRUCTION				**$ 37,588**
Inspection (5%)				$ 1,879
Construction Management (10%)				$ 3,759
R/W COSTS				
TOTAL COSTS				**$ 43,226**

TOTAL COSTS				**$ 2,509,707**

Alt 4A - RCP Bypass along Creek Bank at UPRR

Length = 220 feet reinforced concrete pipe (RCP)

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.08	Acre	$ 50,000	$ 3,800
Culvert				
Concrete volume	204.68	C.Y.	$ 1,500	$ 307,020
Earth Work				
Soil excavation	1466.67	C.Y.	$ 40	$ 58,667
Soil embankment	948.57	C.Y.	$ 40	$ 37,943
Shoring	5280.00	S.F.	$ 26	$ 137,280
Utilities		L.S.	$ 750,000	$ 750,000
Miscellaneous				
Fencing	500.00	L.F.	$ 15	$ 7,500
Traffic Control		L.S.	$ 50,000	$ 50,000
SUBTOTAL				**$ 1,352,210**
Mobilization (10%)				$ 135,221
Construction Contingencies (30%)				$ 405,663
Market Condition (10%)				$ 135,221
Escalation to midpoint (5%)				$ 67,610
TOTAL CONSTRUCTION				**$ 2,095,925**
Inspection (5%)				$ 104,796
Construction Management (10%)				$ 209,592
R/W COSTS				
TOTAL COSTS				**$ 2,410,314**

Alt 4B - UPRR Bridge Replacement

Length = 35 feet   reinforced concrete box (RCB)

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing, Grubbing & site prep	0.03	Acre	$ 50,000	$ 1,500
Culvert & Wingwall				
Bridge concrete vol	120.56	C.Y.	$ 1,500	$ 180,840
Wingwalls	12.14	C.Y.	$ 1,100	$ 13,354
Concrete excavation	51.85	C.Y.	$ 1,000	$ 51,850
Earth Work				
Soil excavation	295.56	C.Y.	$ 40	$ 11,822
Soil embankment	198.33	C.Y.	$ 40	$ 7,933
Shoring	840.00	S.F.	$ 30	$ 25,200
Utilities		L.S.	$ 750,000	$ 750,000
Miscellaneous				
Fencing	70.00	L.F.	$ 20	$ 1,400
Traffic Control		L.S.	$ 50,000	$ 50,000
UPRR coordination		L.S.	$ 150,000	$ 150,000
SUBTOTAL				**$ 1,243,900**
Mobilization (10%)				$ 124,390
Construction Contingencies (30%)				$ 373,170
Market Condition (10%)				$ 124,390
Escalation to midpoint (5%)				$ 62,195
TOTAL CONSTRUCTION				**$ 1,928,044**
Inspection (5%)				$ 96,402
Construction Management (10%)				$ 192,804
R/W COSTS				
TOTAL COSTS				**$ 2,217,251**

Alt 4C - Floodwall U/S UPRR

Length = 650 feet * 2 = 1300 feet (on top of both banks)

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.27	Acre	$ 50,000	$ 13,500
Floodwall				
Concrete volume	601.85	C.Y.	$ 1,000	$ 601,850
Earth Work				
Soil excavation	433.33	C.Y.	$ 40	$ 17,333
Miscellaneous				
Fencing	1300.00	L.F.	$ 15	$ 19,500
Traffic Control		L.S.	$ 50,000	$ 50,000
SUBTOTAL				**$ 702,183**
Mobilization (10%)				$ 70,218
Construction Contingencies (30%)				$ 210,655
Market Condition (10%)				
Escalation to midpoint (5%)				
TOTAL CONSTRUCTION				**$ 983,056**
Inspection (5%)				$ 49,153
Construction Management (10%)				
R/W COSTS	2000.00	S.F.	$ 50.00	$ 100,000
TOTAL COSTS				**$ 1,132,209**

CALABAZAS CREEK MILLER-WARDELL
EROSION REPAIR CONSTRUCTION COSTS SUMMARY TABLE
Project No. 26104001

STA	STA	DESCRIP	COST	ANNUAL O & M (approx 5%)
1	424+33	20' high bank, 22' long erosion on east cal bank. Possible isolated areas of slope failure. Upper bank is nearly vertical, consider planting groundcover. Lower bank may be protected on 1:1 slope using log mattress. Downstream edge borders 3 cottonwood trees at toe line. These trees are to remain. Vegetation Management trims these trees regularly.	$25,415	$1,300
2	425+06	20' high bank, lower 8' needs protection. 19' long erosion on east bank. Bare soil on upper slope that needs groundcover planted for protection.	$24,610	$1,200
3	428+81	Toe erosion, 12.5' long and 5' high. Need ground cover planted on upper slope.	$9,361	$450
4	439+00	Covered in blue tarp. Slope under 12" storm drain is eroded. Fill pocket 9' high, 9' deep and 2' long. Leave other part under tarp intact.	$5,175	$250
5	484+67	East bank is eroded to expose roots of 4 oak trees on top of bank. 36' long steep bank (1/2:1) needs log mattress protection. Also 5' wide bank needs soil and rock fill. Upstream from this site, west bank is protected by geocells. Several dead and live willows near bottom of geocells cause significant downstream erosion problem and should be removed.	$60,318	$3,050
6	489+11	Flow shedding off loose rocks upstream to cause erosion of this site to expose roots of an oak tree. 30' long erosion, 6' high, needs soil and rock protection to 1:1 slope.	$32,775	$2,000
7	494+62	Just upstream of concrete sacks on east bank. Eroded 3'x4'x3' hole near toe and 10' long section 5' high needs rock protection.	$4,945	$150
8	497+18	At Cupertino Creekside Condominium. Erosion around outside bend. Need to remove dead tree trunks. 15' long and 8' high section needs soil and rock fill to connect to existing concrete sacks. Need angular rocks to stay on 1:1 slope. Bend radius 32 ft and channel width 16 ft.	$20,056	$900
9	497+85	Just upstream from CCC site. A bent willow tree in channel will affect flow capacity and should be removed. 37' long and 6' high area, with downstream end around an oak tree, needs soil and angular rock fill. Final slope 1:1.	$22,195	$900
10	498+27	Around outside bend, 56' long 5' deep and 6' high pocket, needs soil and rock fill. Toe line is staked in field. Bend radius 36' and channel width 17'.	$26,163	$1,000
11	556+70	Eddy erosion off edge of concrete sacks. 10' long 7' high section needs rock cover. Up to bottom of oak tree.	$9,718	$350
12	558+50	Erosion of west bank caused by flow shedding off volunteer willow tree in channel bottom. Need to remove willow tree and line channel bank with rocks up to the 4" plastic drain pipe.	$8,855	$300
13	558+93	West bank eroded up to the top of bank, 9 ft high. Remove existing concrete pieces on slope. Fill isolated holes with soil. Cover with rocks and plant cottonwood cuttings 3' from bottom. Final slope 1:1.	$10,868	$550
14	567+93	Failed concrete sack structure around a 30" storm drain pipe. Need to remove existing concrete and concrete sacks and line 8' long, 6' high section with rocks.	$4,945	$300
		TOTALS	**$265,399**	**$12,700**

Repair Site #1 @ Station 424+33

Item	Unit Costs	Amount
Site Preparation		
Mobilization	$ 1,500	$ 1,500
Clearing and grubbing	$ 2,000	$ 2,000
Erosion materials		
Log Mattress	$ 100	$ 15,800
3" rock and gravel mixture	$ 30	$ 1,800
Miscellaneous		
Small plantings	$ 1,000	$ 1,000
SUBTOTAL		$ 22,100
TOTAL CONSTRUCTION		**$ 22,100**
Inspection (5%)		$ 1,105
Construction Management (10%)		$ 2,210
TOTAL COSTS		**$ 25,415**

Log Mattress area
(22 x 8) - (8 x 8) x 1.414 = 158 SF

Rock quantity (3" diameter)
3 x 1 x 20 = 60 CF

Repair Site #2 @ Station 425+06

Item	Unit Costs	Amount
Site Preparation		
Mobilization	$ 1,500	$ 1,500
Clearing and grubbing	$ 2,000	$ 2,000
Erosion materials		
Log Mattress	$ 100	$ 15,400
3" rock and gravel mixture	$ 30	$ 1,500
Miscellaneous		
Plantings	$ 1,000	$ 1,000
SUBTOTAL		$ 21,400
TOTAL CONSTRUCTION		**$ 21,400**
Inspection (5%)		$ 1,070
Construction Management (10%)		$ 2,140
TOTAL COSTS		**$ 24,610**

Log Mattress area
(18.5 + 15)/2 x (8ft high) x 1.146 = 154 SF

Rock quantity (3" diameter)
154 x 1 = 154 CF

Repair Site #3 @ Station 428+81

Item	Unit Costs	Amount
Site Preparation		
Mobilization	$ 1,500	$ 1,500
Clearing and grubbing	$ 2,000	$ 2,000
Erosion materials		
Log Mattress	$ -	$ -
6" rock and gravel mixture	$ 30	$ 2,640
3" rock & gravel mixture	$ 1,000	$ 1,000
Miscellaneous		
Ground cover vegetation	$ 1,000	$ 1,000
SUBTOTAL		$ 8,140
TOTAL CONSTRUCTION		**$ 8,140**
Inspection (5%)		$ 407
Construction Management (10%)		$ 814
TOTAL COSTS		**$ 9,361**

Rock quantity (6" diameter)
(12.5 + 5)/2 x (5 ft high) x (2 ft deep) = 88 CF

Repair Site #4 @ Station 439+00

Item	Unit Costs	Amount
Site Preparation		
Mobilization	$ 1,500	$ 1,500
Clearing and grubbing	$ 2,000	$ 2,000
Erosion materials		
6" cobble / gravel mixture	$ 40	$ 1,000
Miscellaneous		
SUBTOTAL		$ 4,500
TOTAL CONSTRUCTION		**$ 4,500**
Inspection (5%)		$ 225
Construction Management (10%)		$ 450
TOTAL COSTS		**$ 5,175**

Rock quantity (6" diameter)
2 x 9 x 1 x 1.414 = 25 CF

Repair Site #11 @ Station 556+70

Item	Unit Costs	Amount
Site Preparation		
Mobilization	$ 1,500	$ 1,500
Clearing and grubbing	$ 2,000	$ 2,000
Erosion materials		
Rock	$ 50	$ 4,950
Miscellaneous		
SUBTOTAL		$ 8,450
TOTAL CONSTRUCTION		**$ 8,450**
Inspection (5%)		$ 423
Construction Management (10%)		$ 845
TOTAL COSTS		**$ 9,718**

Rock quantity (6" diameter)
70ft long X (7x1.414)ft X 1ft thick = 99 CF

Repair Site 12 @ Station 558+50

Item	Unit Costs	Amount
Site Preparation		
Mobilization	$ 1,500	$ 1,500
Clearing and grubbing	$ 2,000	$ 2,000
Erosion materials		
Rock	$ 50	$ 3,700
Miscellaneous		
Remove willow	$ 500	$ 500
SUBTOTAL		$ 7,700
TOTAL CONSTRUCTION		**$ 7,700**
Inspection (5%)		$ 385
Construction Management (10%)		$ 770
TOTAL COSTS		**$ 8,855**

Rock quantity (6" diameter)
(20ft + 10ft)/2 X (7ft x 1.414)ft X 0.5ft thick = 74 CF

Enhancement Cost Summary

ENHANCEMENT	ESTIMATE COST
Comer Dam Modification	$1,013,050
Regetation D/S Prospect	$50,025
Total	$1,063,075

Comer Enhancement - Alternative 2 (complete replacement)

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Mobilization, Clearing & Grubbing		L.S.	$ 550	$ 100,000
Concrete removal				
Remove top of Comer Dam	204.68	C.Y.	$ 550	$ 50,000
Earth Work				
Soil excavation	2710.00	C.Y.	$ 30	$ 81,300
Soil embankment	559.00	C.Y.	$ 30	$ 16,770
Gravel between drops	310.00	C.Y.	$ 30	$ 9,300
Weirs				
Rock	792.00	TON	$ 200	$ 158,400
Miscellaneous				
Retrofit wall for support	204.68	L.S.	$ 550	$ 50,000
SUBTOTAL				**$ 465,770**
Construction Contingencies (30%)				$ 139,731
Market Condition (10%)				$ 46,577
Escalation to midpoint (5%)				$ 23,289
TOTAL CONSTRUCTION				**$ 675,367**
Planning (10)				$ 67,537
Design (20%)				$ 135,073
Geotechnical (5%)				$ 33,768
Inspection (5%)				$ 33,768
Construction Management (10%)				$ 67,537
R/W COSTS				
TOTAL COSTS				**$ 1,013,050**

Revegetation D/S of Prospect

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Mobilization, Clearing & Grubbing		L.S.	$ 3,000	$ 3,000
Soil preparation (some augering)		L.S.	$ 5,000	$ 5,000
Planting				
Includes installation & irrigation		L.S.	$ 15,000	$ 15,000
SUBTOTAL				**$ 23,000**
Construction Contingencies (30%)				$ 6,900
Market Condition (10%)				$ 2,300
Escalation to midpoint (5%)				$ 1,150
TOTAL CONSTRUCTION				**$ 33,350**
Planning (10)				$ 3,335
Design (20%)				$ 6,670
Geotechnical (5%)				$ 1,668
Inspection (5%)				$ 1,668
Construction Management (10%)				$ 3,335
R/W COSTS				
TOTAL COSTS				**$ 50,025**

F

APPENDIX F

The 1 Percent Flood

APPENDIX F
The 1 Percent Flood

Definition

The 1 percent flood is that flow of water from a drainage area that, on the average and over a long period of time, has a 1 percent chance (probability of 0.01) of being equalled or exceeded in any given year. It is sometimes referred to as the 100-year flood, but it should not be thought of as an event that occurs regularly every 100th year. Instead, it is the flood flow that would be equalled or exceeded perhaps about 100 times in 10,000 years. It is also possible that two repetitions of this flood flow could occur in a single year, or that a single event may not occur even once in 200 years.

The 1 Percent Flood and the 1 Percent Storm

Another terminology problem is relation of the 1 percent storm and the 1 percent flood. Storm magnitude relates to flood magnitude through a complex set of parameters such as antecedent rainfall conditions, drainage basin shape, length, slope, orientation, and other factors. Therefore, a 1 percent storm will not necessarily produce a 1 percent flood. The 1 percent flood should not be confused with nor should it be referred to as the "1 percent storm" or the "1 percent storm flood."

Cumulative Risk

The 1 percent flood has a small risk of occurrence in a given year, but the risk is cumulative. When compared with the 30-year life of the average home loan, for example, the chance that such a flood will occur is quite large. During the 30-year loan period, the chance that a.1 percent flood will occur, or will be exceeded approaches 30 percent

The "1 Percent Flood" and the "Design Flood"

Another relationship that requires explanation is that which exists between the "1 percent flood" and a "design flood " A design flood is any particular flood magnitude chosen for designing a flood control project. A design flood could be the 1 percent flood or it could also be a flood of another frequency of occurrence. The 1 percent design flood (used by the District as its design standard) represents the expected future flow of water from a watershed without constriction, undue storage or delay. The 1 percent flood under existing watershed conditions (the existing 1 percent flood) is the flood developed from a watershed with existing limited capacity channels. Such a flood is used by the Federal Emergency Management Agency as a standard for its flood insurance program.

1 Percent-Peak Flows and 1 Percent Volumes

In general, floods are identified in terms of their peak flows and volumes. In practice, the 1 percent flood refers to the **1 percent peak flow rate** when designing flood control channels and similar water structures. The 1 percent flood also refers to the **1 percent volume** of water when defining overbank storage or when designing flood retention and detention facilities.

The District's Hydrology and the 1 Percent Flood

The magnitude of the 1 percent flood is calculated using statistical hydrologic methods. The District uses a uniform method of determining the 1 percent flood; one that is regional in scope and based on the best available rainfall and runoff information from areas within and adjacent to the County. The regional process utilized by the District was developed after considerable effort and has been reviewed and approved by the academic and professional communities,

Factors Affecting Floods

The major causes of floods are the preceding storms and their intensity distributions. Other factors that would affect the peaks and/or volumes of floods relate to the physical characteristics of watersheds, either rural or urban.

For rural watersheds these factors are: slope, groundcover, basin shape, soil type, etc. For urban watersheds natural conditions are modified by increasing the impervious areas and by making the flow paths more efficient. Roof tops, pavement rain gutters, downspouts, curbs, storm drains, levees and culverts can increase the volumes and peaks of flood flows, especially in hilly terrain with steep slopes. In the flat land, the limited capacity of the storm drainage system and the conditions of the levees along the adjacent channels may reduce the peaks of larger urban floods and thereby retain the water in the urban watershed for a longer time. This may serve to increase local flooding of urban areas and cause no increase in the flow within the main channel. Therefore, depending on the local conditions, urbanization could have the effect of increasing or decreasing the flow in the main channels.

G

APPENDIX G

Hydrology & Hydraulics

SANTA CLARA VALLEY WATER DISTRICT

CALABAZAS CREEK HYDROLOGY REPORT

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February, 2007

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SANTA CLARA VALLEY WATER DISTRICT

CALABAZAS CREEK HYDROLOGY REPORT

1. INTRODUCTION

This report summarizes the work completed on the Calabazas Creek hydrology. Calabazas Creek is within Santa Clara Valley Water District's West Valley Watershed. Presented in the report are recommended design flows for Calabazas Creek and its respective tributaries.

The following is a list of the tributaries analyzed in this study:
Calabazas Creek Hydrology
- Calabazas Creek
- Prospect Creek
- Regnart Creek
- Rodeo Creek

2. HYDROLOGIC MODEL

This section provides a summary of the method and procedures developed and used for the hydrology study of the Calabazas Creek watershed. Refer to the District's publication entitled "Hydrology Procedures (Saah et al, 2006)" for more detailed information.

2.1 Design Storm Precipitation

The design storm precipitation has been obtained by using the Global Regional Equations (Saah et al, 1996) to estimate the flood runoff magnitude applying an appropriate rainfall-runoff model.

From the isohyetal map of mean annual precipitation (MAP), locate the specific location of the site and determine the MAP. Some interpolation may be required to obtain the MAP.

Given the mean annual precipitation for the ungaged site, the precipitation intensity is calculated as:

$$i_{T,D} = \frac{a_1 T^{a_2} \exp[SD_e^{\,2}/2]}{D^{a_3}} \qquad \textbf{(1)}$$

Where:

$i_{T,D}$ = the predicted precipitation intensity in inches per hour or inches per day at return period T

T = return period in years as the recurrence intervals

D = duration D in hours or days

$[a_1, a_2, a_3]$ = model coefficients

SD_e = the standard deviation of the model residuals (random term).

The precipitation depth (in inches) $x_{T,D}$ can be simply obtained from the precipitation intensity $i_{T,D}$ by the following relation:

$$x_{T,D} = i_{T,D} . D$$

For short duration rainfall of a 1% event (specifically for durations of 5 minutes, 10 minutes, up to as much as 24 hours), the model parameters $[a_1, a_2, a_3]$ are estimated as follows:

$$\begin{aligned} a_1 &= 0.2675 + 0.01199 \cdot MAP + 0.00002472 \cdot E \\ a_2 &= 0.167033 \\ a_3 &= 0.5853 - 0.004155 \cdot MAP - 0.000001096 \cdot E \end{aligned}$$

Where:

MAP = the mean annual precipitation in inches
E = the elevation of the ungaged site in feet.

Note that the parameter a_2 is a constant parameter. One more parameter needed in Eq.(1) is the standard deviation of the model residuals (model error term). The standard deviation for the short duration data is SD_e=0.120039. Note that the duration D for short duration rainfall analysis in Eq. (1) is in terms of hours.

The precipitation depth obtained from the Global equations may be checked with nearby rainfall gage stations for validations.

2.2 Flood Flow Regression Model

Since the early 1970s, the District has utilized regional regression and correlation techniques to estimate design flows at ungaged locations. The regional regression equations are formulas consisting of flow information such as values from gaged stations as dependent variables and measurable watershed characteristics as independent variables. The application of these equations on ungaged locations will result in estimates of flood flow from any watershed for certain selected frequencies (e.g. 1% or 10% design flows). Regional equations usually apply to rural watersheds. The District updated the regional regression model in 2003 to include data through 2000 based on the following criteria:

1. Use the historic data. No stochastic data are included.
2. Use the data from Santa Clara County and Santa Cruz County.

Based on these criteria, the data were reevaluated and the results of the statistical analyses have been utilized in this regression analysis. The outcomes of this study are documented in a report entitled *Development of Regional Regression Equations to Calculate Flood Quantiles in Santa Clara County* (Saah et al, 2003). The updated regional regression to estimate 24-hr peaks and 1-day volumes for both the 1% and 10% quantiles are as shown below:

FOR 24-hr PEAKS:

$$Q_{1\%} = 11.22 \times A^{0.954} \times MAP^{1.03}$$

$$Q_{10\%} = 2.985 \times A^{0.988} \times MAP^{1.173}$$

Where:

A = the watershed area in square miles
MAP = the mean annual precipitation in inches

FOR 1-day VOLUMES:

$$V_{1\%} = 2.254 \times A^{0.964} \times MAP^{1.187}$$

$$V_{10\%} = 0.895 \times A^{0.933} \times MAP^{1.244}$$

Where:

A = the watershed area in square miles
MAP = the mean annual precipitation in inches

Note: The 24-hr volume may be approximated by multiplying the 1-day volume by a factor of 1.15.

2.3 Loss Rates

The loss rates for the rural and pervious parts of sub-watersheds are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. For all impervious areas, loss rates are assumed to be minimal. The hydrologic soil type, the Antecedent Moisture Content (AMC) and the ground cover are defined for each sub-watershed and are used to determine the respective Initial Abstraction (Ia) and the CN for AMCII which represent an average watershed condition.

The Antecedent Moisture Conditions are further calibrated for various watershed conditions and various frequencies of occurrences using the flood volumes obtained from the regression model and those obtained from the rainfall-runoff model. Based on this information, the Ia and CN values for the updated AMC are calculated and input into the HEC-1 model. A map of hydrologic soil types for each watershed is included in the appendices.

For the rural and pervious parts of the watershed, the loss parameters are validated or adjusted based on the calibration process with flood flow regression equations. This process of calibration has made the rainfall-generated flood quantiles more reliable.

2.4 Clark's Synthetic Hydrograph Parameters (Tc and R)

The unit hydrograph parameters applicable to this study are calculated and presented for each creek. Rural, pervious and impervious parts of each sub-watershed are considered separately. The Time of Concentration (Tc) is calculated using Kirby Hathaway's formula:

$$Tc = 0.01377[(L * n)^{0.47} S^{-0.235}]$$

Where:

L=distance of overland flow in feet (ft)
n=Manning's watershed roughness coefficient
S=average slope in ft/ft

The Routing Coefficient (R) is calculated based on an acceptable routing indicator: R/(Tc+R). This indicator directly impacts the peaking characteristics of hydrographs. For rural and pervious sub-sub-watersheds, the indicator is assumed to range between 0.5 and 0.9 based on the calibration process with regression quantiles. For impervious sub-sub watersheds, the indicator is assumed to range between 0.1 and 0.5.

2.5 Urban Hydrology

In 1996, an urban hydrology procedure (Wang and Saah 1996) was developed which addressed the impact of urban growth on flood flows, and this procedure is used for Calabazas Creek. This procedure accounts for the effects on runoff due to two major urban changes: increased imperviousness and increased channelization. Increased imperviousness reduces the overland flow travel time and thus increases the volume of flow. Increased channelization addresses the impact of conveyance through gutters and storm drains together with the increased storage capability of these facilities. The effects of channelization are most pronounced in flat terrain with slopes less than 0.003. Imperviousness represents coverage from streets, buildings and other lot coverage. The coverage from streets in urban residential areas ranges from 2% to 25%, while for other land uses the value can be as high as 95% of the total lot area. The concept of "Equivalent Street" is obtained from the land use requirements for ratio of streets as a part of the total urban sub-watershed. Based on this equivalent street concept, the length and width of streets in an urbanized area are defined and, hence, the unit hydrograph parameters are calculated. The following are the formulas used in this study to calculate unit hydrograph parameters as input to HEC-1.

Equivalent street length (all measurements are in ft or square ft) is calculated by the equation:

$$L_{st}=A_{st}/W_{st}$$

Where:

L_{st} = the equivalent street length
A_{st} = area of streets, (from land use guidelines)
W_{st} = width of streets (from traffic guidelines)

Overland flow length is calculated by the equations:

$$L_i = (A_i - A_{st})/2L_{st}$$
$$L_p = A_p/2L_{st}$$

Where:

L_i = length of overland flow of impervious area
A_i = impervious area, (from land use guidelines)
L_p = length of overland flow of pervious area
A_p = pervious area

The impervious length of overland flow is given by the equation $L_{imp} = L_i + L_{Cb}$ where L_{Cb} is the length of flow to the first catch basin (normally less than 300 ft), and L_i is defined above. The pervious length is given by the equation $L_{perv} = L_p + L_{imp}$.

The Time of Concentration (Tc) is calculated separately for pervious and impervious areas using Kirby-Hathaway's formula as defined in Section 2.4. Time of Concentration for impervious areas is calculated as:

$$Tc_{imp} = Tc_i + Tc_{cb}$$

Where:

Tc_{imp} = Time of Concentration for the impervious area
Tc_i = Time of Concentration of overland flow over impervious area
Tc_{cb} = Time of Concentration of flow length to first catch basin

Time of concentration for pervious areas is calculated as:

$$Tc_{perv} = Tc_p + Tc_{imp}$$

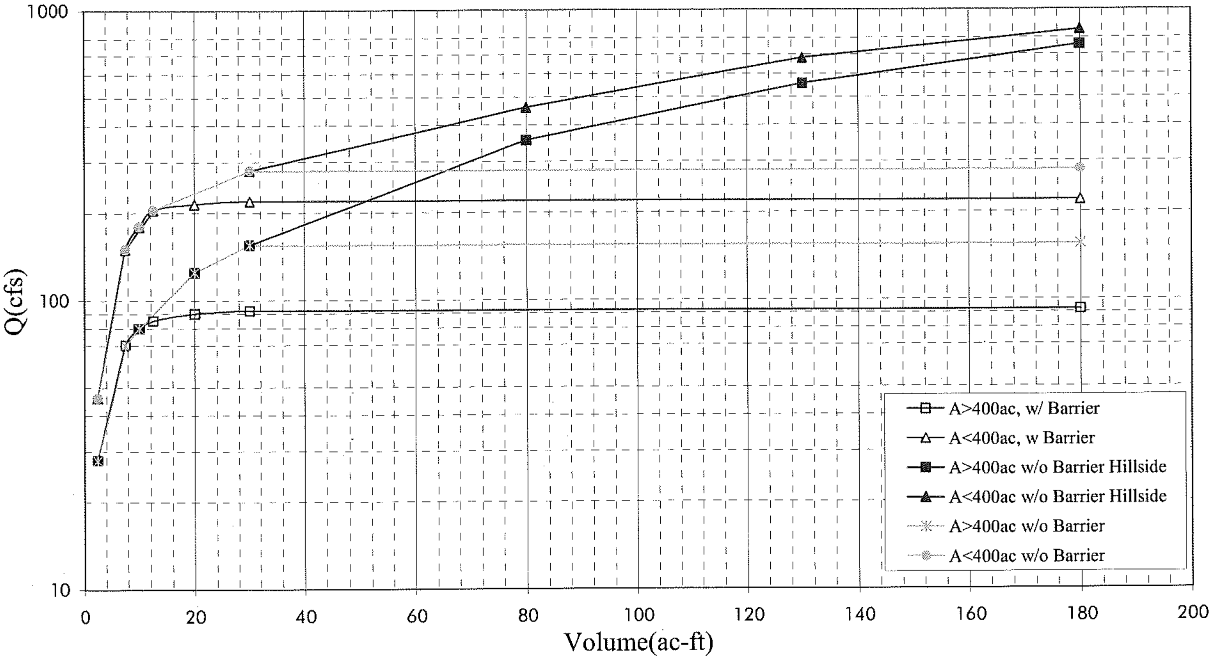
Where:

Tc_{perv} = Time of Concentration for pervious area
Tc_p = Time of Concentration of overland flow over pervious area
Tc_{imp} = Time of Concentration of the impervious length of overland flow

2.6 Routing Procedures

Most of the flood waters from urban areas are conveyed to flood control channels via storm drain systems. Figure 1 shows the general unitized (prorated to one square mile of an area) storage-discharge rating curves that may be applied to valley urban areas. The combined pervious and impervious inflow hydrographs for a study area are routed through the storm drains using the modified pulse routing method. The storage-discharge relationship for that area is calculated from a unitized relationship and applied to obtain the outflow from the storm drain system. The storage routing usually consists of two types of boundary conditions: namely, "with barrier" (eg. berms, levees, houses and etc.) and "without barrier" conditions. The "with barrier" conditions can be found in the lower parts of a watershed, where the lay of the land has flat or mild slopes (generally less than 0.02). Here, the urban runoff can only reach the creeks through the storm drain system, without the possibility of overland connections. The "without barrier" condition generally exists at the upper part of a watershed where slopes are steep (generally greater than 0.02), or in areas without flood control improvements. Runoff water from these areas without barriers normally finds its overland course and eventually reaches the creek channels.

Figure 1. General Unitized Storage-Discharge Rating Curve (prorated to one square mile of an area)



3. DESIGN HYDROGRAPH ESTIMATION FOR RURAL AND URBAN WATERSHEDS

The hydrologic modeling tool adopted for this study is the HEC-1 Flood Hydrograph Package developed by the U.S. Army Corps of Engineers (1990).

The HEC-1 model has several optional procedures to simulate the various components of the rainfall-runoff process in a watershed. Based on previous modeling studies of rural and urban watersheds around the Santa Clara Valley, the approach adopted by the District in the use of the HEC-1 model for rainfall-runoff modeling is summarized as follows:

- The land use is based Santa Clara County Parcel Data (2001), and Santa Clara County Ortho Photos (2001).
- The SCS curve number is calculated based on Hydrologic Soil Groups in Santa Clara County published by the United States Department of Agriculture, Soil Conservation Service.
- The longest rural channel is defined as a sum of the main channel length and overland flow length. The slope for the basin is calculated using the elevation difference divided by the longest rural length.
- A watershed boundary is delineated using the 7.5-minute Digital Elevation Model available from USGS. For rural areas, the boundary will follow the contour lines. For urban areas, the boundary will follow the street, storm drain system and the contour.
- The SCVWD Maps of Flood Control Facilities and Limits of 1% Flooding are utilized for channel routing information.

4. CALABAZAS CREEK HYDROLOGY

Calabazas Creek Watershed originates at 1,920 feet above mean sea level in the Santa Cruz Mountains and flows north through the Cities of Sunnyvale and Santa Clara. As the Creek reaches near Highway 280, it receives part of the diverted flow from Juiper Serra Channel after a portion of the flow diverted to Sunnvale East Channel. It meets San Tomas Aquino Creek at sea level near San Francisco Bay. The total drainage area is 22.7 square miles, of which 2.2 square miles are rural. The basin receives an average annual rainfall ranging from 39 inches in the headwaters to 13.5 inches near the Bay. There are no reservoirs on Calabazas Creek which function as flood control facilities.

There are three rainfall stations that collectively represent the precipitation patterns on the watershed. These stations are listed below:

• #48	Sunnyvale WPCP
• #77	Valley Christian
• #121	Mtn. View Corp. Yard

Applying the Global equations, the rainfall input range for a 24-hr duration varies from 7.5 inches (1%) and 5.1 inches (10%) for sub-basin A to 4.1 inches (1%) and 2.8 inches (10%) for sub-basin M. These values are very close to the weighted rainfall amounts calculated from the rain gages.

Appendix A contains tables and figures that present the hydrologic characteristics and design flows for Calabazas Creek.

REFERENCES

Saah A.D., J. Wang, W. Chang and N. Lee, 2006. *Hydrology Procedures*, SCVWD, San Jose, CA.

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United States Department of Agriculture, 1968. *Soil Conservation Services, Soil of Santa Clara County*, Berkeley, CA. August.

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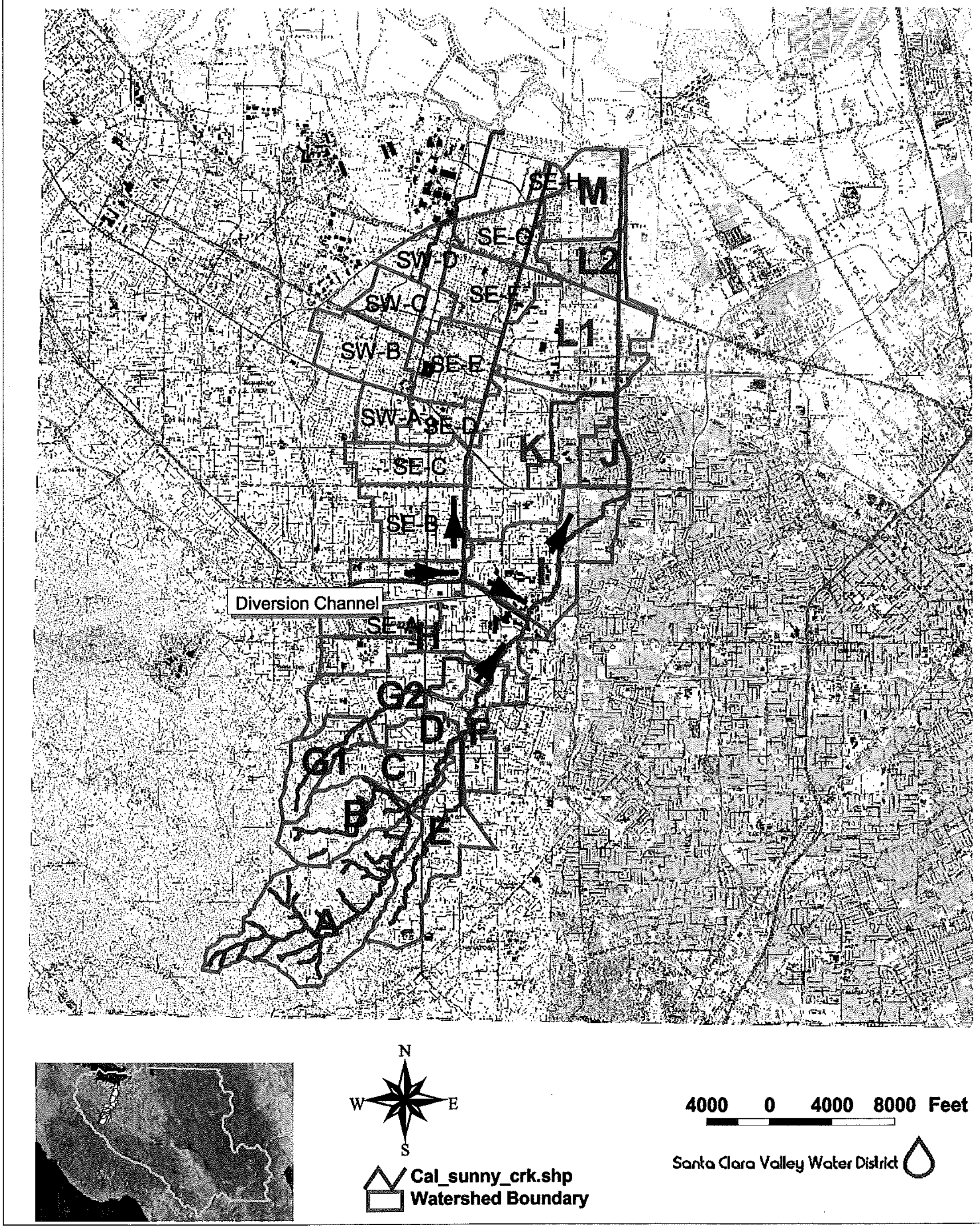
APPENDIX A
CALABAZAS CREEK
HYDROLOGY INFORMATION

Design Flow of Calabazas Creek

Location	Drainage Area	PEAK FLOW (cfs)						
		2.33 year(*)	5 year(*)	10 year	25 year(*)	50 year(*)	100 year	500 year(*)
	mi^2	Q 43%	Q 20%	Q 10%	Q 4%	Q 2%	Q 1%	Q 0.2%
Calabazas Creek u/s Prospect Creek	2.88	320	500	650	840	970	1,100	1,400
Prospect Creek u/s Calabazas Creek	1.17	80	130	170	220	260	290	360
Calabazas Creek d/s Prospect Creek	4.05	370	600	800	1,000	1,200	1,400	1,800
Calabazas Creek u/s Rodeo Creek	5.30	500	770	980	1,200	1,400	1,600	2,000
Rodeo Creek u/s Calabazas Creek	1.48	120	170	210	260	290	320	380
Calabazas Creek d/s Rodeo Creek	6.78	600	930	1,200	1,500	1,800	2,000	2,500
Calabazas Creek u/s Regnart Creek	7.57	670	1,000	1,300	1,600	1,900	2,100	2,600
Regnart Creek u/s Calabazas Creek	2.32	210	300	370	450	510	560	670
Calabazas Creek d/s Regnart Creek	9.89	860	1,300	1,650	2,100	2,400	2,650	3,250
Calabazas Creek @ I-280	11.65	1,100	1,500	1,900	2,300	2,600	2,900	3,500
Calabazas Creek @ El Camino Real	13.81	1,200	1,700	2,050	2,500	2,800	3,050	3,600
Calabazas Creek u/s El Camino storm drain (@ Monroe St, near Willcox High School)	14.27	1,200	1,700	2,100	2,600	2,900	3,150	3,750
El Camino storm drain u/s Calabazas Creek	2.79	170	240	300	370	410	450	540
Calabazas Creek d/s El Camino storm drain (@ SPRR)	17.06	1,400	2,000	2,400	2,900	3,300	3,600	4,300
Calabazas Creek @US 101	19.31	1,500	2,100	2,600	3,100	3,500	3,800	4,500
Calabazas Creek d/s Hwy 237 @ pump station	21.14	1,600	2,200	2,650	3,200	3,600	3,900	4,600

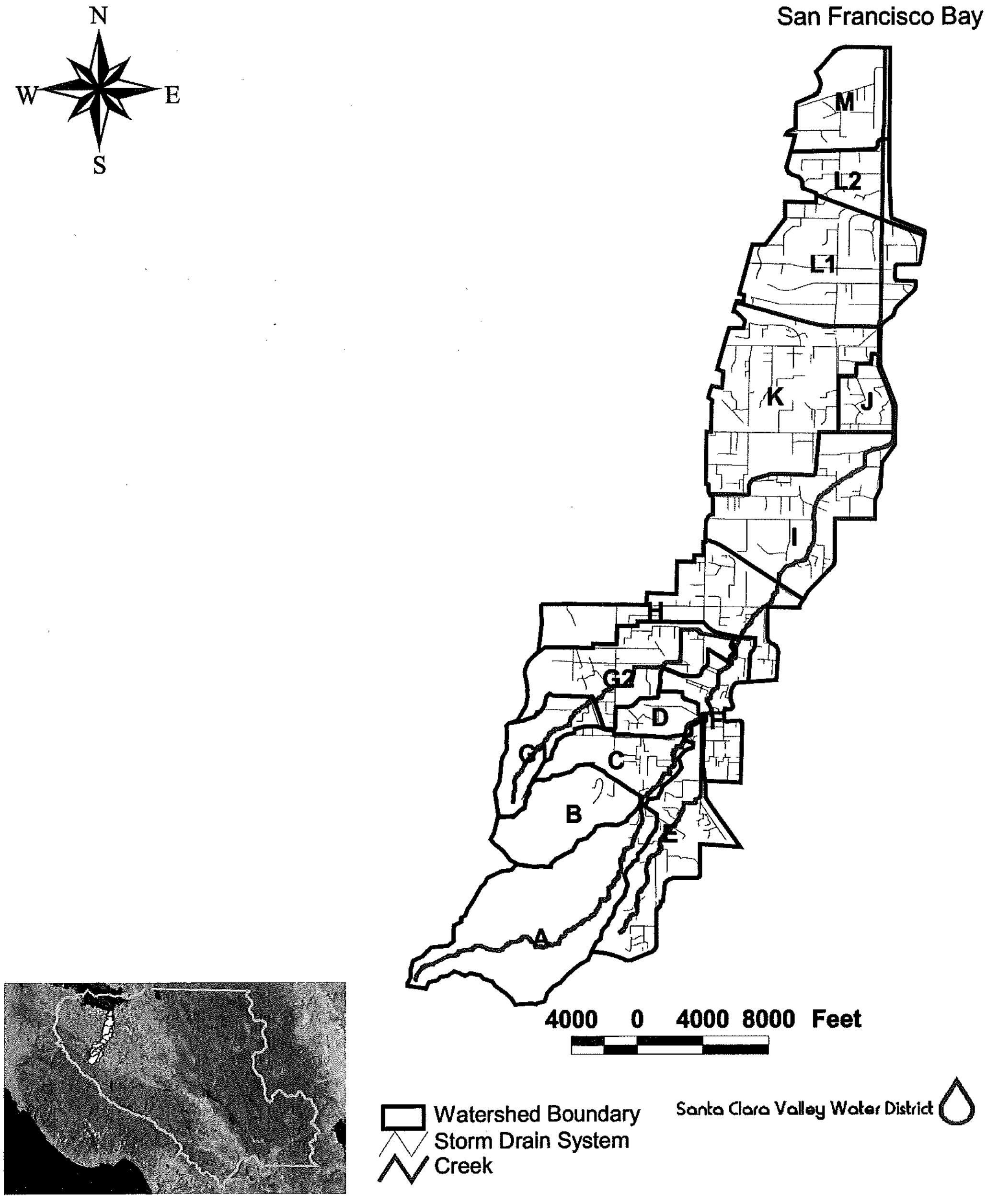
- (*) extrapolated and interpolated by using log Pearson Type III distribution.

Calabazas Creek Watershed Boundary



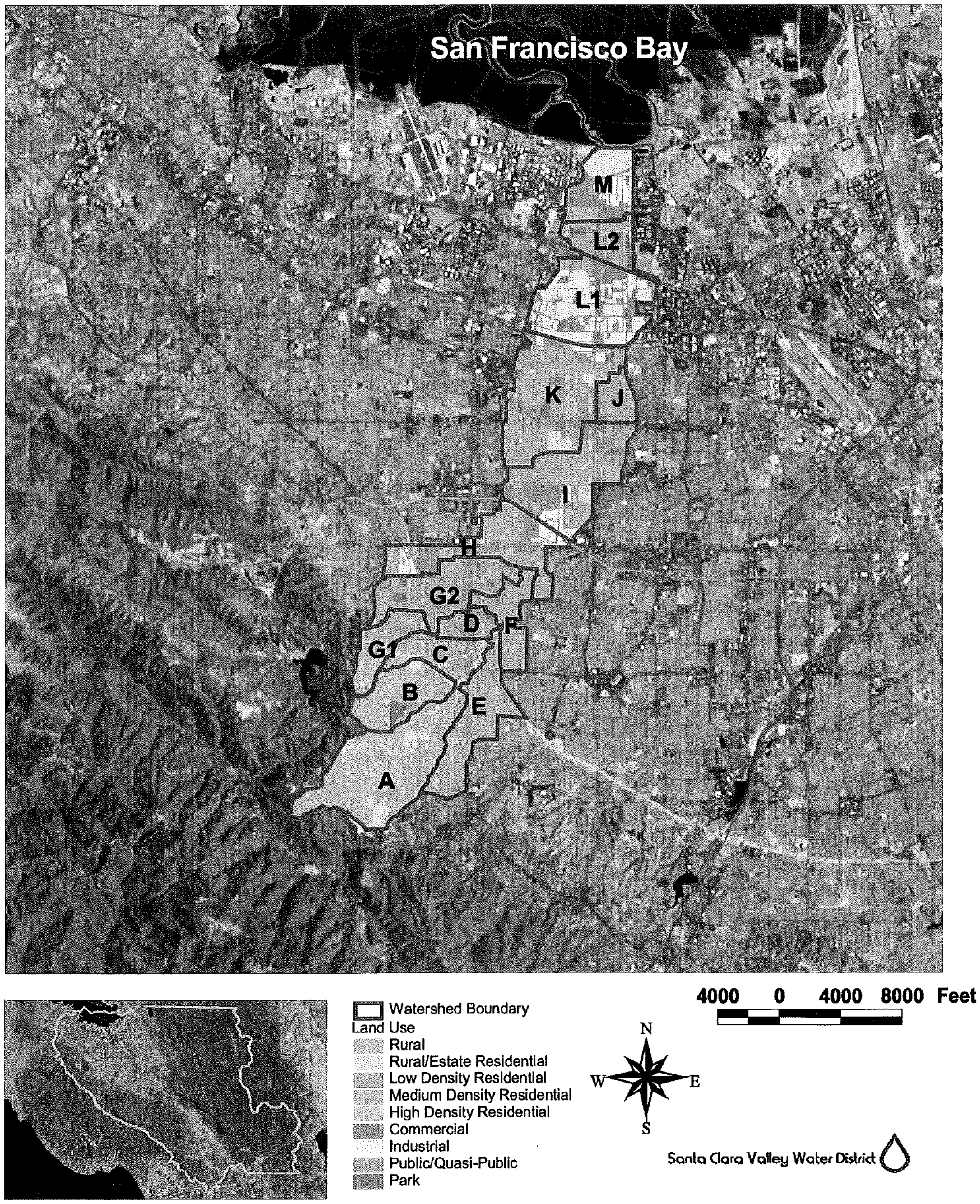
Storm Drain System

Calabazas Creeks Watershed



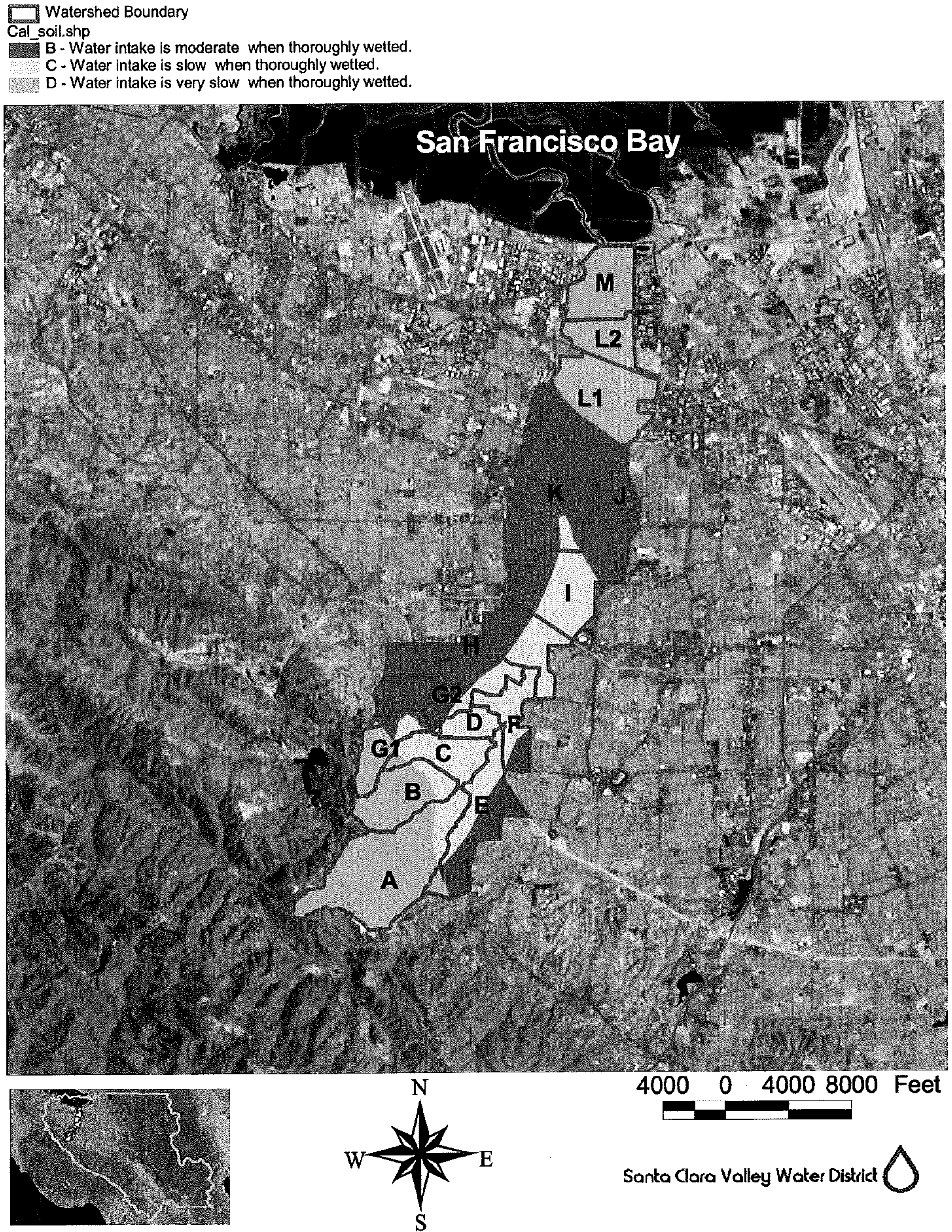
Land Use

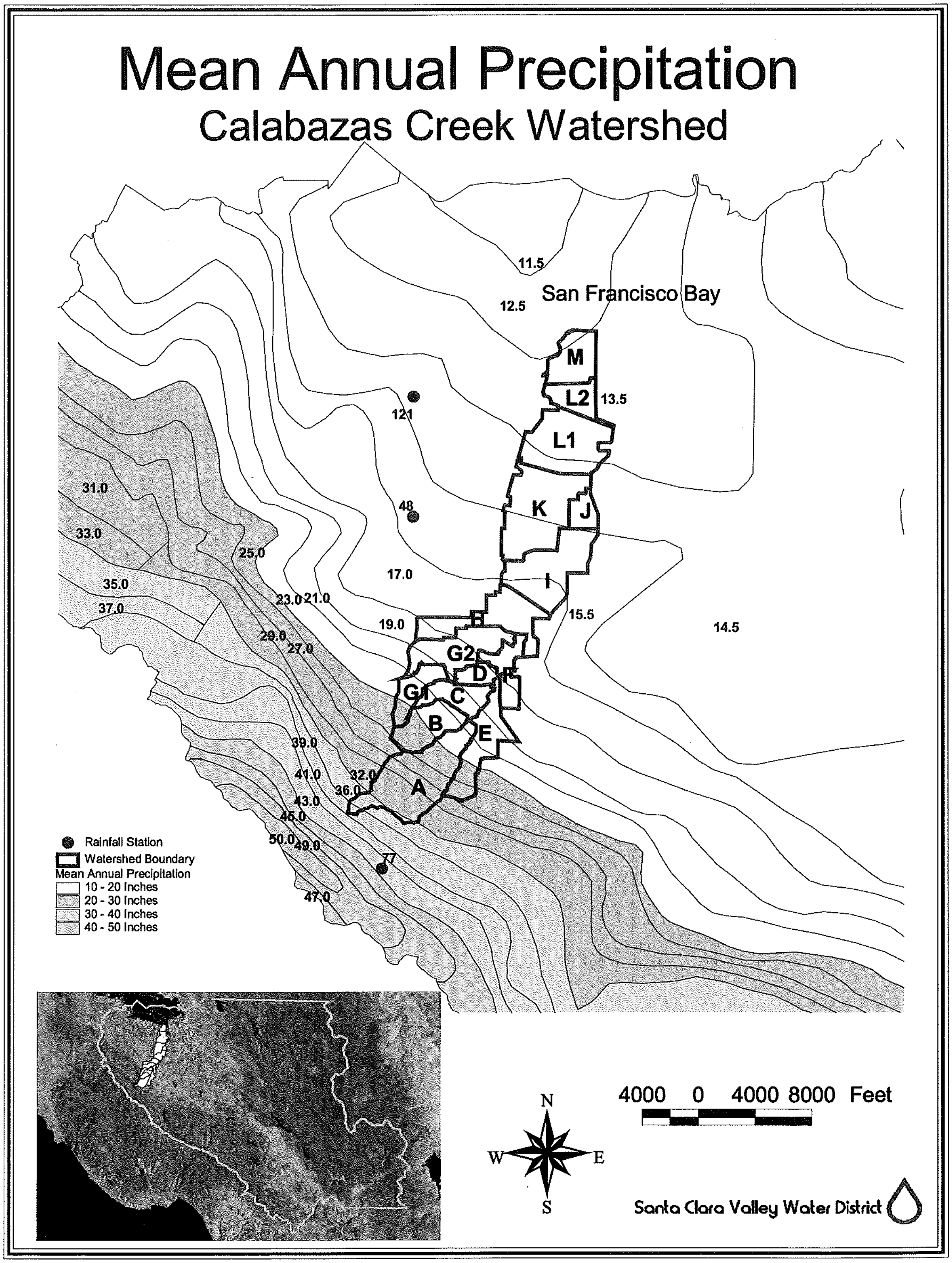
Calabazas Creek Watershed



Soil Type

Calabazas Creek Watershed


Watershed Boundary
Cal_soil.shp
B - Water intake is moderate when thoroughly wetted.
C - Water intake is slow when thoroughly wetted.
D - Water intake is very slow when thoroughly wetted.
San Francisco Bay
M
L2
L1
K
J
I
H
G2
D
F
G1
C
B
E
A
N
W
E
S
4000 0 4000 8000 Feet
Santa Clara Valley Water District



Mean Annual Precipitation

Calabazas Creek Watershed

Calabazas Creek (1% HEC-1 Input Data)

BASIN	Total Area 1	Rural Area 2	Perv Area 3	Imp Area 4	Rural Ia - Calc 5	Rural CN 6	Perv Ia - Calc 7	Perv CN 8	Imp Ia - Calc 9	Imp CN 10	Rural Tc 11	Rural R 12	Perv Tc 13	Perv R 14	Imp Tc 15	Imp R 16
A	2.88	1.35	0.69	0.84	0.59	77	0.42	83	0.04	98	0.49	1.97	0.37	1.47	0.22	0.15
B	1.17	0.61	0.25	0.31	0.59	77	0.45	82	0.04	98	0.38	2.17	0.49	2.77	0.25	0.17
C	0.85	0.11	0.22	0.52	0.68	75	0.56	78	0.04	98	0.26	1.48	0.35	1.99	0.22	0.15
D	0.40		0.10	0.30			0.56	78	0.04	98			0.36	2.03	0.23	0.15
E	1.48		0.44	1.04			0.80	72	0.04	98			0.38	2.15	0.23	0.16
F	0.79		0.24	0.55			0.65	75	0.04	98			0.36	2.06	0.23	0.15
G1	0.75	0.14	0.21	0.40	0.62	76	0.56	78	0.04	98	0.32	1.79	0.28	1.60	0.20	0.13
G2	1.57		0.47	1.10			0.92	69	0.04	98			0.37	2.08	0.23	0.15
H	1.76		0.35	1.41			0.84	71	0.04	98			0.34	1.91	0.23	0.15
I	2.16		0.54	1.62			0.80	72	0.04	98			0.39	2.19	0.24	0.16
J	0.46		0.12	0.35			1.03	66	0.04	98			0.42	2.39	0.25	0.17
K	2.79		0.84	1.95			0.99	67	0.04	98			0.43	0.43	0.25	0.16
L1	2.25		0.22	2.03			0.56	78	0.04	98			0.36	2.04	0.26	0.17
L2	0.73		0.22	0.51			0.40	84	0.04	98			0.46	2.58	0.26	0.17
M	1.10		0.33	0.77			0.40	84	0.04	98			0.49	0.49	0.27	0.18

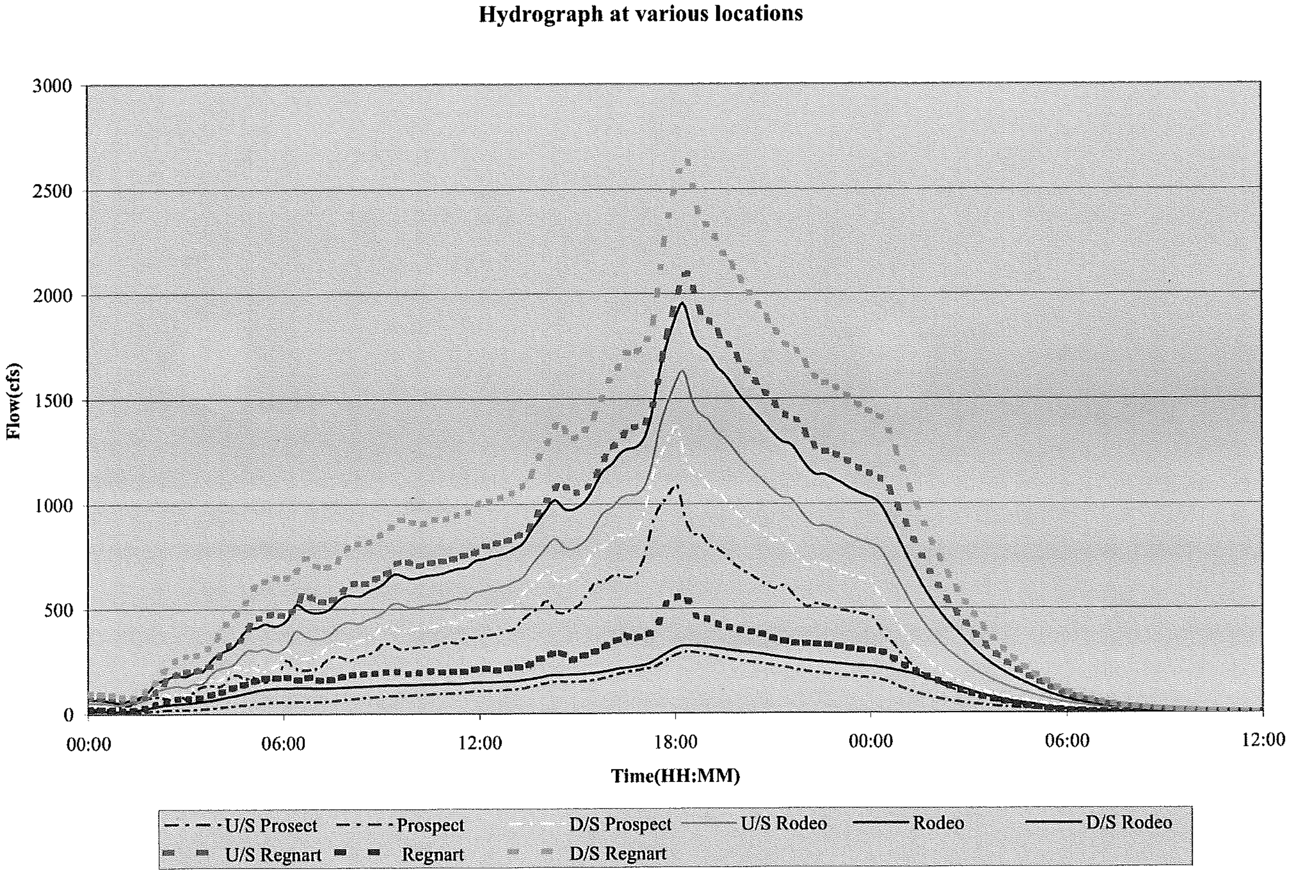
1. Total area of the sub-watershed in square miles
2. The rural part of the sub-watershed, area in square miles
3. The pervious part of the sub-watershed, area in square miles
4. The impervious part of the sub-watershed, area in square miles
5. Initial Abstraction (Ia) for rural area
6. Curve Number(CN) for rural area
7. Initial Abstraction (Ia) for pervious area
8. Curve Number(CN) for pervious area
9. Initial Abstraction (Ia) for impervious area
10. Curve Number(CN) for impervious area
11. Times of Concentration(Tc) for rural area
12. Clark's Storage Routing Coefficient R for rural area
13. Times of Concentration(Tc) for pervious area
14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area

Calabazas Creek (10% HEC-1 Input Data)

BASIN	Total Area 1	Rural Area 2	Perv Area 3	Imp Area 4	Rural Ia - Calc 5	Rural CN 6	Perv Ia - Calc 7	Perv CN 8	Imp Ia - Calc 9	Imp CN 10	Rural Tc 11	Rural R 12	Perv Tc 13	Perv R 14	Imp Tc 15	Imp R 16
A	2.88	1.35	0.69	0.84	0.93	68	0.68	75	0.04	98	0.49	1.97	0.37	1.47	0.22	0.15
B	1.17	0.61	0.25	0.31	0.93	68	0.72	74	0.04	98	0.38	2.17	0.49	2.77	0.25	0.17
C	0.85	0.11	0.22	0.52	1.08	65	0.88	69	0.04	98	0.26	1.48	0.35	1.99	0.22	0.15
D	0.40		0.10	0.30			0.88	69	0.04	98			0.36	2.03	0.23	0.15
E	1.48		0.44	1.04			1.23	62	0.04	98			0.38	2.15	0.23	0.16
F	0.79		0.24	0.55			1.03	66	0.04	98			0.36	2.06	0.23	0.15
G1	0.75	0.14	0.21	0.40	0.98	67	0.88	69	0.04	98	0.32	1.79	0.28	1.60	0.20	0.13
G2	1.57		0.47	1.10			1.39	59	0.04	98			0.37	2.08	0.23	0.15
H	1.76		0.35	1.41			1.28	61	0.04	98			0.34	1.91	0.23	0.15
I	2.16		0.54	1.62			1.23	62	0.04	98			0.39	2.19	0.24	0.16
J	0.46		0.12	0.35			1.57	56	0.04	98			0.42	2.39	0.25	0.17
K	2.79		0.84	1.95			1.51	57	0.04	98			0.43	0.43	0.25	0.16
L1	2.25		0.22	2.03			0.88	69	0.04	98			0.36	2.04	0.26	0.17
L2	0.73		0.22	0.51			0.65	76	0.04	98			0.46	2.58	0.26	0.17
M	1.10		0.33	0.77			0.65	76	0.04	98			0.49	0.49	0.27	0.18

1. Total area of the sub-watershed in square miles
2. The rural part of the sub-watershed, area in square miles
3. The pervious part of the sub-watershed, area in square miles
4. The impervious part of the sub-watershed, area in square miles
5. Initial Abstraction (Ia) for rural area
6. Curve Number(CN) for rural area
7. Initial Abstraction (Ia) for pervious area
8. Curve Number(CN) for pervious area
9. Initial Abstraction (Ia) for impervious area
10. Curve Number(CN) for impervious area
11. Times of Concentration(Tc) for rural area
12. Clark's Storage Routing Coefficient R for rural area
13. Times of Concentration(Tc) for pervious area
14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area

Design Flow Hydrographs



Design Flow Hydrograph Tables

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
36892	29	12	41	53	15	68	76	23	99
01/01/2050 0:05	27	12	39	53	15	68	76	23	99
01/01/2050 0:10	25	12	37	53	15	67	76	23	99
01/01/2050 0:15	24	11	35	53	14	67	75	23	98
01/01/2050 0:20	22	11	34	52	14	66	75	22	97
01/01/2050 0:25	21	11	32	52	13	65	75	22	97
01/01/2050 0:30	21	11	32	51	13	64	75	21	96
01/01/2050 0:35	23	10	33	49	12	62	74	21	95
01/01/2050 0:40	26	9	35	47	12	59	73	20	93
01/01/2050 0:45	31	8	39	45	12	57	72	20	92
01/01/2050 0:50	35	8	43	44	12	55	71	19	89
01/01/2050 0:55	37	7	44	42	12	54	69	18	86
01/01/2050 1:00	37	7	44	42	12	54	66	17	83
01/01/2050 1:05	38	7	45	43	12	55	64	17	81
01/01/2050 1:10	40	7	47	46	13	59	62	17	79
01/01/2050 1:15	43	7	50	50	14	64	61	17	78
01/01/2050 1:20	47	8	55	53	15	69	61	17	78
01/01/2050 1:25	57	8	65	56	17	73	62	19	81
01/01/2050 1:30	68	9	77	58	19	77	65	20	85
01/01/2050 1:35	75	10	85	61	21	82	70	23	93
01/01/2050 1:40	78	11	88	64	23	88	75	26	101
01/01/2050 1:45	77	12	89	70	26	95	81	29	110
01/01/2050 1:50	78	12	90	78	28	106	86	33	119
01/01/2050 1:55	79	13	92	90	30	120	92	36	128
01/01/2050 2:00	81	14	95	102	33	134	98	41	139
01/01/2050 2:05	82	15	97	110	35	145	106	46	152
01/01/2050 2:10	82	16	98	115	38	153	117	51	168
01/01/2050 2:15	81	17	98	118	41	159	131	56	187
01/01/2050 2:20	79	18	97	122	43	164	147	58	205
01/01/2050 2:25	75	19	94	125	44	169	161	60	221
01/01/2050 2:30	71	19	90	129	45	174	171	63	233
01/01/2050 2:35	70	19	89	131	46	178	178	66	245
01/01/2050 2:40	75	20	94	133	47	180	184	70	255
01/01/2050 2:45	82	20	101	133	48	181	190	73	264
01/01/2050 2:50	85	20	104	132	48	180	196	75	271
01/01/2050 2:55	81	20	101	130	49	179	199	76	275
01/01/2050 3:00	74	20	94	129	50	179	202	75	277
01/01/2050 3:05	74	21	95	132	51	183	203	74	277
01/01/2050 3:10	86	21	107	138	53	190	203	73	276
01/01/2050 3:15	103	22	124	143	54	197	203	73	276

	U/S	Prospect	D/S	U/S	Rodeo	D/S	U/S	Regnart	D/S
Date / Time	Prosect		Prospect	Rodeo		Rodeo	Regnart		Regnart
	100YR	100YR	100YR	100YR	100YR	100YR	100YR	100YR	100YR
	CFS	CFS	CFS	CFS	CFS	CFS	CFS	CFS	CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 3:20	115	23	138	144	55	199	205	75	280
01/01/2050 3:25	124	23	147	142	57	199	210	77	287
01/01/2050 3:30	130	24	154	142	59	201	218	80	298
01/01/2050 3:35	134	25	159	153	60	213	224	84	308
01/01/2050 3:40	135	26	161	170	62	233	227	88	315
01/01/2050 3:45	135	27	162	188	64	252	229	92	320
01/01/2050 3:50	135	28	163	200	66	266	236	96	331
01/01/2050 3:55	133	29	162	209	69	278	252	99	351
01/01/2050 4:00	131	30	161	215	71	286	274	102	376
01/01/2050 4:05	133	32	165	219	74	293	293	105	398
01/01/2050 4:10	143	33	176	222	76	299	307	108	415
01/01/2050 4:15	157	34	192	225	79	304	318	113	431
01/01/2050 4:20	169	36	204	227	82	309	327	119	446
01/01/2050 4:25	178	37	215	231	84	316	334	124	458
01/01/2050 4:30	186	38	224	241	87	328	341	128	469
01/01/2050 4:35	188	40	228	256	90	346	347	132	480
01/01/2050 4:40	182	41	223	272	93	365	356	136	492
01/01/2050 4:45	172	42	214	287	96	383	368	140	508
01/01/2050 4:50	167	44	211	299	99	397	387	144	531
01/01/2050 4:55	170	45	215	305	102	407	408	148	556
01/01/2050 5:00	176	46	222	306	105	411	428	153	581
01/01/2050 5:05	177	48	225	303	108	410	444	157	601
01/01/2050 5:10	170	49	219	301	110	411	454	161	615
01/01/2050 5:15	159	50	210	304	113	416	459	165	624
01/01/2050 5:20	153	51	204	309	115	424	461	168	628
01/01/2050 5:25	152	52	204	313	117	430	462	170	633
01/01/2050 5:30	154	53	208	310	119	429	468	172	640
01/01/2050 5:35	158	55	213	304	120	424	475	173	648
01/01/2050 5:40	164	56	220	298	122	420	480	173	653
01/01/2050 5:45	172	56	228	296	122	419	480	172	652
01/01/2050 5:50	184	57	241	298	123	422	476	173	649
01/01/2050 5:55	210	57	266	303	124	427	472	174	646
01/01/2050 6:00	239	57	296	311	124	434	472	176	647
01/01/2050 6:05	256	56	312	321	123	444	475	176	651
01/01/2050 6:10	251	56	306	336	123	459	481	174	655
01/01/2050 6:15	236	56	292	360	123	483	489	171	661
01/01/2050 6:20	225	57	282	385	124	509	501	168	669
01/01/2050 6:25	216	58	274	399	125	524	518	165	683
01/01/2050 6:30	211	58	269	396	125	521	542	162	704
01/01/2050 6:35	208	58	267	385	125	510	566	160	726

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 6:40	208	58	266	374	125	499	576	165	741
01/01/2050 6:45	210	58	268	367	124	491	572	173	745
01/01/2050 6:50	212	58	270	362	124	486	561	177	738
01/01/2050 6:55	214	58	272	360	124	483	551	173	724
01/01/2050 7:00	216	58	274	359	123	482	544	166	710
01/01/2050 7:05	220	58	278	360	123	483	540	162	702
01/01/2050 7:10	231	58	289	362	123	485	537	160	697
01/01/2050 7:15	244	58	303	365	123	488	537	161	698
01/01/2050 7:20	255	59	314	369	123	492	538	162	700
01/01/2050 7:25	264	60	324	376	123	499	541	163	704
01/01/2050 7:30	272	61	333	387	124	510	545	165	709
01/01/2050 7:35	276	63	338	400	124	525	550	166	716
01/01/2050 7:40	275	64	339	413	125	538	559	170	728
01/01/2050 7:45	272	65	337	423	126	549	571	175	746
01/01/2050 7:50	268	67	335	431	126	558	586	179	765
01/01/2050 7:55	263	68	331	436	127	563	599	182	781
01/01/2050 8:00	258	69	327	438	128	565	610	184	794
01/01/2050 8:05	257	70	328	437	128	565	618	186	804
01/01/2050 8:10	262	71	334	435	129	564	623	187	810
01/01/2050 8:15	269	73	342	433	129	562	625	187	812
01/01/2050 8:20	275	74	348	432	130	562	624	188	812
01/01/2050 8:25	278	75	352	434	130	565	623	189	812
01/01/2050 8:30	280	76	355	441	131	571	623	190	813
01/01/2050 8:35	282	77	359	449	131	580	624	191	815
01/01/2050 8:40	287	78	365	455	132	587	629	192	820
01/01/2050 8:45	294	79	373	460	133	593	636	193	829
01/01/2050 8:50	302	80	382	464	134	598	645	194	839
01/01/2050 8:55	314	81	396	470	134	604	652	196	848
01/01/2050 9:00	328	83	411	477	135	612	658	197	855
01/01/2050 9:05	337	84	421	486	136	622	664	199	863
01/01/2050 9:10	338	85	423	498	137	635	671	200	871
01/01/2050 9:15	336	86	421	512	137	649	680	201	881
01/01/2050 9:20	331	86	418	524	137	661	691	202	893
01/01/2050 9:25	323	86	410	530	137	667	704	202	907
01/01/2050 9:30	314	87	401	530	137	667	717	203	920
01/01/2050 9:35	309	87	396	527	137	665	727	201	927
01/01/2050 9:40	308	88	396	522	138	660	730	196	927
01/01/2050 9:45	310	88	398	515	138	653	729	192	922
01/01/2050 9:50	312	88	400	510	138	648	726	192	917
01/01/2050 9:55	314	89	403	507	138	645	720	195	915

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 10:00	317	89	406	508	138	646	714	200	914
01/01/2050 10:05	318	90	408	509	139	648	710	201	911
01/01/2050 10:10	319	91	410	512	139	651	709	197	906
01/01/2050 10:15	319	92	410	515	140	654	711	194	905
01/01/2050 10:20	319	92	411	518	140	658	713	194	908
01/01/2050 10:25	319	93	412	520	140	660	717	199	915
01/01/2050 10:30	320	93	413	521	140	662	720	204	924
01/01/2050 10:35	321	94	415	522	140	663	723	205	928
01/01/2050 10:40	325	94	419	523	141	664	725	202	927
01/01/2050 10:45	330	95	424	525	141	666	726	199	925
01/01/2050 10:50	334	95	429	527	141	668	728	198	926
01/01/2050 10:55	337	96	433	530	142	672	729	199	928
01/01/2050 11:00	341	96	437	534	142	676	731	200	931
01/01/2050 11:05	342	97	439	538	142	681	734	200	934
01/01/2050 11:10	340	97	437	543	142	685	738	201	939
01/01/2050 11:15	337	98	435	546	143	689	742	202	944
01/01/2050 11:20	337	99	436	549	143	692	747	202	949
01/01/2050 11:25	346	100	446	550	144	694	751	201	953
01/01/2050 11:30	357	101	458	550	145	694	755	201	956
01/01/2050 11:35	365	103	467	551	146	697	758	202	959
01/01/2050 11:40	366	104	470	557	147	703	759	204	963
01/01/2050 11:45	364	106	469	567	148	715	761	208	968
01/01/2050 11:50	363	107	470	578	149	726	765	211	976
01/01/2050 11:55	365	108	473	584	149	733	775	215	989
01/01/2050 12:00	369	109	478	586	149	735	786	218	1004
01/01/2050 12:05	373	109	482	587	150	736	795	218	1014
01/01/2050 12:10	374	109	484	589	150	739	800	217	1017
01/01/2050 12:15	375	110	485	594	150	744	802	215	1017
01/01/2050 12:20	377	110	487	598	150	749	804	212	1017
01/01/2050 12:25	379	110	489	601	151	752	808	210	1018
01/01/2050 12:30	381	111	492	603	151	755	813	208	1021
01/01/2050 12:35	384	112	496	605	152	757	817	208	1026
01/01/2050 12:40	388	113	501	607	153	760	820	211	1032
01/01/2050 12:45	392	113	506	610	153	763	823	215	1038
01/01/2050 12:50	396	114	510	614	154	768	826	217	1043
01/01/2050 12:55	398	115	513	620	154	774	829	218	1047
01/01/2050 13:00	400	116	516	626	155	780	834	219	1052
01/01/2050 13:05	406	117	523	632	155	787	840	220	1060
01/01/2050 13:10	420	118	537	637	156	794	847	221	1068
01/01/2050 13:15	436	119	556	643	157	801	854	223	1077

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peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 13:20	450	121	572	652	159	811	862	225	1086
01/01/2050 13:25	462	124	585	666	161	827	870	227	1097
01/01/2050 13:30	471	126	598	685	163	848	880	231	1111
01/01/2050 13:35	480	129	609	704	165	869	895	238	1133
01/01/2050 13:40	489	132	621	721	167	888	915	248	1163
01/01/2050 13:45	498	135	633	737	169	906	938	257	1195
01/01/2050 13:50	508	138	646	752	171	923	959	261	1220
01/01/2050 13:55	520	141	661	767	174	941	979	263	1242
01/01/2050 14:00	533	143	676	783	177	960	998	267	1265
01/01/2050 14:05	536	146	682	800	180	980	1017	274	1291
01/01/2050 14:10	522	149	671	817	182	999	1037	281	1318
01/01/2050 14:15	502	151	652	830	183	1014	1058	288	1346
01/01/2050 14:20	488	152	639	835	184	1018	1077	293	1370
01/01/2050 14:25	481	152	633	826	184	1010	1093	295	1388
01/01/2050 14:30	478	152	631	810	184	994	1099	291	1390
01/01/2050 14:35	479	152	631	796	184	980	1094	279	1373
01/01/2050 14:40	484	151	635	788	184	972	1080	265	1345
01/01/2050 14:45	490	151	640	785	185	970	1065	255	1321
01/01/2050 14:50	495	151	646	786	185	971	1056	254	1310
01/01/2050 14:55	502	151	653	789	186	975	1053	260	1313
01/01/2050 15:00	510	152	662	795	187	982	1054	267	1322
01/01/2050 15:05	520	153	673	803	187	990	1058	272	1330
01/01/2050 15:10	538	154	692	812	188	1000	1065	275	1340
01/01/2050 15:15	558	155	713	824	189	1013	1075	279	1354
01/01/2050 15:20	576	156	732	839	190	1029	1086	284	1369
01/01/2050 15:25	595	158	753	858	191	1050	1099	288	1388
01/01/2050 15:30	614	159	773	881	193	1074	1116	293	1409
01/01/2050 15:35	626	161	787	904	194	1098	1138	297	1435
01/01/2050 15:40	628	164	792	926	196	1122	1162	302	1465
01/01/2050 15:45	626	166	793	946	198	1144	1189	309	1497
01/01/2050 15:50	628	169	798	961	200	1161	1214	317	1531
01/01/2050 15:55	637	173	809	969	202	1171	1237	326	1563
01/01/2050 16:00	648	176	825	975	205	1179	1256	334	1590
01/01/2050 16:05	657	180	837	984	208	1191	1270	339	1609
01/01/2050 16:10	660	184	844	998	210	1208	1280	345	1625
01/01/2050 16:15	660	188	848	1014	213	1227	1292	354	1646
01/01/2050 16:20	659	192	851	1027	215	1242	1309	366	1675
01/01/2050 16:25	655	195	850	1036	216	1252	1328	375	1703
01/01/2050 16:30	650	197	847	1040	218	1258	1344	374	1718

Date / Time	U/S Prosect	Prospect	D/S Prospect	U/S Rodeo	Rodeo	D/S Rodeo	U/S Regnart	Regnart	D/S Regnart
	100YR	100YR	100YR	100YR	100YR	100YR	100YR	100YR	100YR
	CFS	CFS	CFS	CFS	CFS	CFS	CFS	CFS	CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 16:35	649	199	848	1042	220	1262	1355	364	1719
01/01/2050 16:40	653	201	854	1042	221	1264	1361	354	1716
01/01/2050 16:45	658	203	861	1043	223	1266	1365	352	1717
01/01/2050 16:50	670	205	875	1046	225	1271	1368	357	1725
01/01/2050 16:55	694	208	902	1054	227	1281	1372	365	1736
01/01/2050 17:00	723	210	933	1067	229	1296	1378	370	1748
01/01/2050 17:05	758	213	970	1088	232	1320	1389	374	1763
01/01/2050 17:10	811	215	1026	1119	236	1355	1407	378	1784
01/01/2050 17:15	870	218	1088	1159	242	1401	1432	383	1816
01/01/2050 17:20	916	221	1137	1210	249	1459	1470	391	1861
01/01/2050 17:25	949	226	1175	1272	256	1528	1520	406	1926
01/01/2050 17:30	975	233	1207	1335	265	1599	1582	434	2016
01/01/2050 17:35	996	240	1236	1387	273	1660	1654	474	2128
01/01/2050 17:40	1014	249	1262	1428	281	1709	1728	507	2236
01/01/2050 17:45	1031	257	1287	1465	289	1754	1793	522	2316
01/01/2050 17:50	1049	264	1313	1500	296	1796	1847	530	2377
01/01/2050 17:55	1068	271	1339	1533	303	1836	1895	541	2436
01/01/2050 18:00	1087	277	1364	1565	310	1874	1941	550	2491
01/01/2050 18:05	1084	283	1367	1597	315	1912	1985	556	2540
01/01/2050 18:10	1035	288	1323	1624	320	1943	2026	559	2585
01/01/2050 18:15	968	292	1260	1634	322	1956	2064	557	2620
01/01/2050 18:20	919	294	1213	1616	323	1939	2091	548	2639
01/01/2050 18:25	887	294	1182	1570	322	1892	2097	534	2631
01/01/2050 18:30	866	293	1159	1517	322	1839	2074	513	2587
01/01/2050 18:35	854	291	1145	1478	321	1799	2027	488	2515
01/01/2050 18:40	851	289	1140	1452	321	1772	1976	466	2442
01/01/2050 18:45	852	287	1139	1433	320	1753	1937	455	2392
01/01/2050 18:50	847	285	1132	1421	319	1740	1912	453	2365
01/01/2050 18:55	832	283	1115	1414	318	1732	1894	453	2347
01/01/2050 19:00	813	281	1095	1407	316	1723	1880	450	2331
01/01/2050 19:05	800	279	1078	1393	314	1708	1871	445	2315
01/01/2050 19:10	792	276	1069	1374	312	1686	1860	439	2298
01/01/2050 19:15	788	274	1062	1354	310	1665	1843	432	2275
01/01/2050 19:20	783	271	1054	1339	309	1647	1822	424	2246
01/01/2050 19:25	773	268	1041	1327	307	1634	1800	416	2216
01/01/2050 19:30	761	266	1027	1317	305	1622	1782	411	2194
01/01/2050 19:35	749	263	1012	1305	303	1609	1769	410	2178
01/01/2050 19:40	736	261	997	1291	301	1592	1756	410	2165
01/01/2050 19:45	722	259	981	1275	300	1574	1741	408	2149
01/01/2050 19:50	711	256	967	1258	298	1556	1724	404	2128

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 19:55	702	254	956	1241	296	1537	1706	400	2106
01/01/2050 20:00	693	252	945	1225	295	1520	1687	397	2083
01/01/2050 20:05	685	250	935	1209	293	1502	1668	394	2062
01/01/2050 20:10	677	248	925	1195	292	1487	1649	392	2041
01/01/2050 20:15	669	247	916	1181	290	1472	1631	391	2022
01/01/2050 20:20	661	245	906	1168	289	1457	1615	389	2003
01/01/2050 20:25	653	243	896	1156	287	1443	1599	387	1986
01/01/2050 20:30	645	242	887	1143	286	1429	1584	385	1969
01/01/2050 20:35	637	240	877	1131	284	1415	1569	383	1952
01/01/2050 20:40	628	238	867	1118	282	1400	1554	380	1933
01/01/2050 20:45	620	236	856	1106	280	1386	1539	376	1914
01/01/2050 20:50	612	234	846	1093	278	1371	1523	370	1893
01/01/2050 20:55	605	232	836	1081	276	1356	1508	364	1872
01/01/2050 21:00	597	229	827	1068	274	1342	1493	359	1851
01/01/2050 21:05	594	227	822	1056	271	1328	1477	355	1833
01/01/2050 21:10	600	225	824	1045	269	1314	1462	352	1814
01/01/2050 21:15	608	223	831	1035	267	1302	1448	348	1796
01/01/2050 21:20	610	220	830	1029	265	1293	1434	345	1779
01/01/2050 21:25	602	218	820	1027	263	1289	1421	342	1763
01/01/2050 21:30	588	216	804	1027	261	1287	1412	339	1751
01/01/2050 21:35	575	213	788	1022	259	1281	1406	336	1742
01/01/2050 21:40	561	210	771	1010	257	1267	1403	334	1736
01/01/2050 21:45	546	207	753	994	255	1249	1396	332	1728
01/01/2050 21:50	534	205	739	976	254	1230	1383	332	1714
01/01/2050 21:55	522	203	725	958	252	1210	1364	332	1696
01/01/2050 22:00	512	201	712	940	251	1191	1344	332	1677
01/01/2050 22:05	506	199	705	925	249	1174	1325	332	1656
01/01/2050 22:10	510	197	707	911	248	1159	1306	331	1636
01/01/2050 22:15	517	195	713	900	247	1147	1288	330	1618
01/01/2050 22:20	521	194	715	893	246	1139	1273	329	1602
01/01/2050 22:25	521	192	713	892	245	1137	1260	328	1589
01/01/2050 22:30	518	191	709	895	243	1138	1252	327	1579
01/01/2050 22:35	515	190	705	896	242	1138	1248	327	1575
01/01/2050 22:40	512	189	701	893	241	1134	1248	327	1575
01/01/2050 22:45	510	187	697	889	240	1128	1248	326	1574
01/01/2050 22:50	507	186	693	883	238	1122	1244	324	1569
01/01/2050 22:55	503	185	687	878	237	1115	1238	322	1560
01/01/2050 23:00	497	183	680	873	236	1109	1231	319	1550
01/01/2050 23:05	493	182	675	868	234	1102	1224	317	1541
01/01/2050 23:10	490	180	670	861	233	1094	1217	314	1531

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peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/01/2050 23:15	487	179	666	853	231	1085	1209	312	1521
01/01/2050 23:20	484	177	662	846	230	1076	1201	310	1511
01/01/2050 23:25	482	176	658	840	229	1069	1192	308	1499
01/01/2050 23:30	479	174	653	835	228	1062	1182	305	1488
01/01/2050 23:35	477	173	649	830	226	1056	1174	303	1477
01/01/2050 23:40	474	171	645	825	225	1050	1167	301	1468
01/01/2050 23:45	471	170	641	820	224	1045	1160	299	1460
01/01/2050 23:50	469	169	638	816	223	1039	1154	298	1452
01/01/2050 23:55	467	168	634	812	222	1034	1148	297	1446
36893	464	167	631	807	221	1029	1142	297	1439
01/02/2050 0:05	453	165	618	803	220	1023	1137	296	1432
01/02/2050 0:10	434	163	597	798	219	1017	1131	294	1425
01/02/2050 0:15	416	161	577	790	218	1008	1125	293	1417
01/02/2050 0:20	398	158	556	777	216	992	1117	291	1408
01/02/2050 0:25	381	154	535	756	214	970	1107	288	1395
01/02/2050 0:30	365	150	515	733	212	945	1092	282	1375
01/02/2050 0:35	350	145	495	710	209	920	1070	274	1345
01/02/2050 0:40	335	139	474	688	207	894	1045	264	1309
01/02/2050 0:45	319	134	453	665	204	869	1018	255	1273
01/02/2050 0:50	304	128	432	642	202	844	991	247	1238
01/02/2050 0:55	288	123	411	619	199	818	965	238	1203
01/02/2050 1:00	273	118	391	595	196	791	938	230	1168
01/02/2050 1:05	259	113	372	571	193	765	911	223	1133
01/02/2050 1:10	245	108	354	548	190	738	883	215	1098
01/02/2050 1:15	233	104	337	525	188	713	856	208	1064
01/02/2050 1:20	221	99	321	503	185	688	828	201	1029
01/02/2050 1:25	211	95	306	482	180	662	801	195	996
01/02/2050 1:30	200	91	292	461	176	637	774	189	963
01/02/2050 1:35	191	87	278	442	172	614	748	183	931
01/02/2050 1:40	182	84	266	424	168	592	722	177	899
01/02/2050 1:45	173	80	254	407	163	570	697	171	868
01/02/2050 1:50	165	77	242	390	159	549	673	166	839
01/02/2050 1:55	157	74	231	374	155	530	650	161	811
01/02/2050 2:00	150	71	221	359	151	511	628	156	784
01/02/2050 2:05	143	68	212	345	148	493	606	151	758
01/02/2050 2:10	137	66	202	332	144	475	585	146	731
01/02/2050 2:15	131	63	194	319	140	459	565	139	704
01/02/2050 2:20	125	61	185	306	137	443	545	134	679
01/02/2050 2:25	119	58	178	294	133	427	526	128	654

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/02/2050 2:30	114	56	170	283	130	413	508	123	631
01/02/2050 2:35	109	54	163	272	126	399	491	117	608
01/02/2050 2:40	104	52	156	262	123	385	474	113	587
01/02/2050 2:45	100	50	150	252	120	372	458	108	566
01/02/2050 2:50	95	48	144	243	115	358	443	103	546
01/02/2050 2:55	91	47	138	233	111	344	428	99	527
01/02/2050 3:00	87	45	132	224	106	330	413	95	508
01/02/2050 3:05	84	43	127	215	102	317	398	91	489
01/02/2050 3:10	80	42	122	206	98	304	383	87	470
01/02/2050 3:15	77	40	117	198	94	292	368	83	452
01/02/2050 3:20	73	39	112	191	90	281	354	80	434
01/02/2050 3:25	70	38	108	183	86	269	340	77	417
01/02/2050 3:30	67	36	103	176	83	259	327	73	401
01/02/2050 3:35	64	35	99	169	79	249	315	70	385
01/02/2050 3:40	62	34	95	162	76	239	303	67	370
01/02/2050 3:45	59	32	92	156	73	229	291	64	356
01/02/2050 3:50	57	31	88	150	70	220	280	62	342
01/02/2050 3:55	54	30	85	144	67	212	269	59	329
01/02/2050 4:00	52	29	81	139	65	203	259	57	316
01/02/2050 4:05	50	28	78	134	62	195	249	54	304
01/02/2050 4:10	48	27	75	128	59	188	240	52	292
01/02/2050 4:15	46	26	72	123	57	180	231	50	281
01/02/2050 4:20	44	25	69	118	55	173	222	47	268
01/02/2050 4:25	42	24	67	114	52	166	213	44	257
01/02/2050 4:30	40	24	64	109	50	160	204	41	245
01/02/2050 4:35	39	23	61	105	48	153	196	38	235
01/02/2050 4:40	37	22	59	101	46	147	188	36	224
01/02/2050 4:45	35	21	57	97	44	141	181	34	215
01/02/2050 4:50	34	20	54	93	43	136	174	32	205
01/02/2050 4:55	32	20	52	89	40	130	167	30	196
01/02/2050 5:00	31	19	50	86	38	123	160	28	188
01/02/2050 5:05	30	18	48	82	35	117	154	26	180
01/02/2050 5:10	28	18	46	78	33	111	148	25	172
01/02/2050 5:15	27	17	44	75	31	106	141	23	165
01/02/2050 5:20	26	17	42	71	29	100	135	22	157
01/02/2050 5:25	25	16	41	68	27	95	128	20	149
01/02/2050 5:30	23	15	39	65	25	90	122	19	141
01/02/2050 5:35	22	15	37	62	24	86	116	18	134
01/02/2050 5:40	21	14	36	59	22	82	110	17	127
01/02/2050 5:45	20	14	34	57	21	78	104	16	120

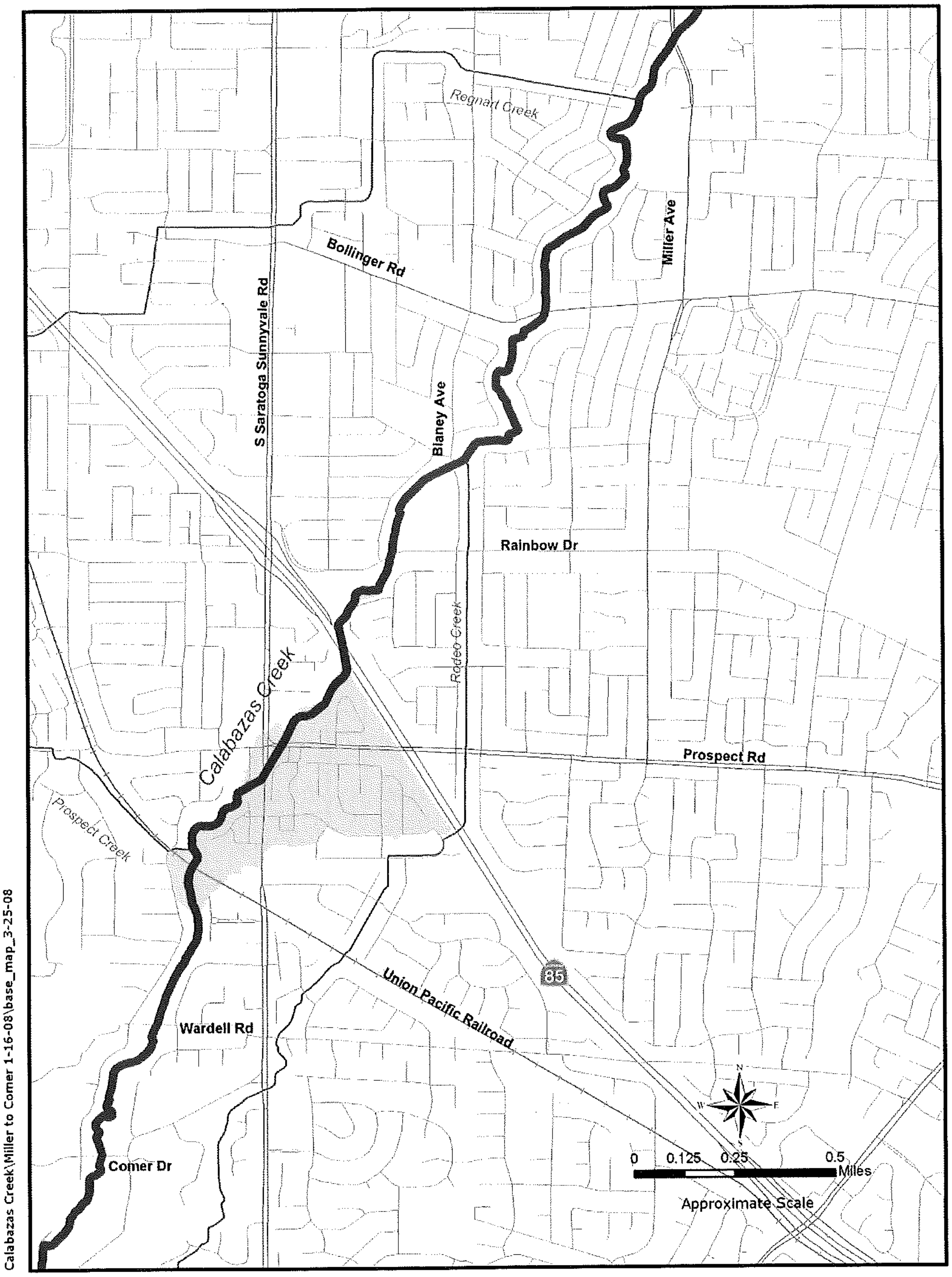
Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/02/2050 5:50	19	13	33	54	20	74	99	15	114
01/02/2050 5:55	19	13	31	52	18	70	94	14	108
01/02/2050 6:00	18	12	30	49	17	66	90	13	103
01/02/2050 6:05	17	12	29	47	16	63	85	12	97
01/02/2050 6:10	16	11	27	45	15	60	81	12	92
01/02/2050 6:15	15	11	26	43	14	57	77	11	88
01/02/2050 6:20	15	10	25	41	13	54	73	10	83
01/02/2050 6:25	14	10	24	39	13	51	69	10	79
01/02/2050 6:30	13	10	23	37	12	49	66	9	75
01/02/2050 6:35	13	9	22	35	11	46	62	9	71
01/02/2050 6:40	12	9	21	34	10	44	59	8	67
01/02/2050 6:45	12	9	20	32	10	42	56	8	64
01/02/2050 6:50	11	8	19	31	9	40	54	7	61
01/02/2050 6:55	10	8	19	29	9	38	51	7	58
01/02/2050 7:00	10	8	18	28	8	36	49	6	55
01/02/2050 7:05	9	8	17	27	8	35	46	6	52
01/02/2050 7:10	9	7	16	26	7	33	44	6	50
01/02/2050 7:15	9	7	16	25	7	31	42	5	47
01/02/2050 7:20	8	7	15	23	6	30	40	5	45
01/02/2050 7:25	8	6	14	22	6	28	38	5	43
01/02/2050 7:30	7	6	14	21	6	27	36	5	41
01/02/2050 7:35	7	6	13	20	5	26	34	4	39
01/02/2050 7:40	7	6	13	20	5	25	33	4	37
01/02/2050 7:45	6	6	12	19	5	23	31	4	35
01/02/2050 7:50	6	5	11	18	4	22	30	4	33
01/02/2050 7:55	6	5	11	17	4	21	28	3	32
01/02/2050 8:00	6	5	10	16	4	20	27	3	30
01/02/2050 8:05	5	5	10	16	4	19	26	3	29
01/02/2050 8:10	5	5	10	15	4	18	25	3	27
01/02/2050 8:15	5	4	9	14	3	18	23	3	26
01/02/2050 8:20	5	4	9	14	3	17	22	3	25
01/02/2050 8:25	4	4	8	13	3	16	21	2	24
01/02/2050 8:30	4	4	8	12	3	15	20	2	23
01/02/2050 8:35	4	4	8	12	3	15	19	2	21
01/02/2050 8:40	4	4	7	11	3	14	18	2	20
01/02/2050 8:45	4	3	7	11	2	13	18	2	19
01/02/2050 8:50	3	3	7	10	2	13	17	2	19
01/02/2050 8:55	3	3	6	10	2	12	16	2	18
01/02/2050 9:00	3	3	6	9	2	11	15	2	17
01/02/2050 9:05	3	3	6	9	2	11	15	1	16

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/02/2050 9:10	3	3	5	9	2	10	14	1	15
01/02/2050 9:15	3	3	5	8	2	10	13	1	15
01/02/2050 9:20	2	3	5	8	2	9	13	1	14
01/02/2050 9:25	2	2	5	7	2	9	12	1	13
01/02/2050 9:30	2	2	5	7	1	8	11	1	13
01/02/2050 9:35	2	2	4	7	1	8	11	1	12
01/02/2050 9:40	2	2	4	6	1	8	10	1	11
01/02/2050 9:45	2	2	4	6	1	7	10	1	11
01/02/2050 9:50	2	2	4	6	1	7	9	1	10
01/02/2050 9:55	2	2	4	6	1	7	9	1	10
01/02/2050 10:00	2	2	3	5	1	6	9	1	9
01/02/2050 10:05	1	2	3	5	1	6	8	1	9
01/02/2050 10:10	1	2	3	5	1	6	8	1	8
01/02/2050 10:15	1	2	3	5	1	5	7	1	8
01/02/2050 10:20	1	2	3	4	1	5	7	1	8
01/02/2050 10:25	1	1	3	4	1	5	7	1	7
01/02/2050 10:30	1	1	2	4	1	5	6	1	7
01/02/2050 10:35	1	1	2	4	1	4	6	0	7
01/02/2050 10:40	1	1	2	4	1	4	6	0	6
01/02/2050 10:45	1	1	2	3	1	4	5	0	6
01/02/2050 10:50	1	1	2	3	1	4	5	0	6
01/02/2050 10:55	1	1	2	3	1	3	5	0	5
01/02/2050 11:00	1	1	2	3	0	3	5	0	5
01/02/2050 11:05	1	1	2	3	0	3	4	0	5
01/02/2050 11:10	1	1	1	2	0	3	4	0	4
01/02/2050 11:15	0	1	1	2	0	3	4	0	4
01/02/2050 11:20	0	1	1	2	0	3	4	0	4
01/02/2050 11:25	0	1	1	2	0	2	4	0	4
01/02/2050 11:30	0	1	1	2	0	2	3	0	4
01/02/2050 11:35	0	1	1	2	0	2	3	0	3
01/02/2050 11:40	0	1	1	2	0	2	3	0	3
01/02/2050 11:45	0	1	1	2	0	2	3	0	3
01/02/2050 11:50	0	1	1	2	0	2	3	0	3
01/02/2050 11:55	0	1	1	1	0	2	2	0	3
01/02/2050 12:00	0	1	1	1	0	2	2	0	2
01/02/2050 12:05	0	1	1	1	0	1	2	0	2
01/02/2050 12:10	0	0	1	1	0	1	2	0	2
01/02/2050 12:15	0	0	1	1	0	1	2	0	2
01/02/2050 12:20	0	0	1	1	0	1	2	0	2
01/02/2050 12:25	0	0	1	1	0	1	2	0	2

Date / Time	U/S Prosect 100YR CFS	Prospect 100YR CFS	D/S Prospect 100YR CFS	U/S Rodeo 100YR CFS	Rodeo 100YR CFS	D/S Rodeo 100YR CFS	U/S Regnart 100YR CFS	Regnart 100YR CFS	D/S Regnart 100YR CFS
peak	**1087**	**294**	**1367**	**1634**	**323**	**1956**	**2097**	**559**	**2639**
01/02/2050 12:30	0	0	1	1	0	1	2	0	2
01/02/2050 12:35	0	0	0	1	0	1	1	0	2
01/02/2050 12:40	0	0	0	1	0	1	1	0	1
01/02/2050 12:45	0	0	0	1	0	1	1	0	1
01/02/2050 12:50	0	0	0	1	0	1	1	0	1
01/02/2050 12:55	0	0	0	1	0	1	1	0	1
01/02/2050 13:00	0	0	0	1	0	1	1	0	1
01/02/2050 13:05	0	0	0	1	0	1	1	0	1
01/02/2050 13:10	0	0	0	1	0	1	1	0	1
01/02/2050 13:15	0	0	0	1	0	1	1	0	1
01/02/2050 13:20	0	0	0	0	0	1	1	0	1
01/02/2050 13:25	0	0	0	0	0	1	1	0	1
01/02/2050 13:30	0	0	0	0	0	0	1	0	1
01/02/2050 13:35	0	0	0	0	0	0	1	0	1
01/02/2050 13:40	0	0	0	0	0	0	1	0	1
01/02/2050 13:45	0	0	0	0	0	0	1	0	1
01/02/2050 13:50	0	0	0	0	0	0	1	0	1
01/02/2050 13:55	0	0	0	0	0	0	1	0	1
01/02/2050 14:00	0	0	0	0	0	0	1	0	1
01/02/2050 14:05	0	0	0	0	0	0	0	0	1
01/02/2050 14:10	0	0	0	0	0	0	0	0	0
01/02/2050 14:15	0	0	0	0	0	0	0	0	0
01/02/2050 14:20	0	0	0	0	0	0	0	0	0
01/02/2050 14:25	0	0	0	0	0	0	0	0	0
01/02/2050 14:30	0	0	0	0	0	0	0	0	0
01/02/2050 14:35	0	0	0	0	0	0	0	0	0
01/02/2050 14:40	0	0	0	0	0	0	0	0	0
01/02/2050 14:45	0	0	0	0	0	0	0	0	0
01/02/2050 14:50	0	0	0	0	0	0	0	0	0
01/02/2050 14:55	0	0	0	0	0	0	0	0	0
01/02/2050 15:00	0	0	0	0	0	0	0	0	0
01/02/2050 15:05	0	0	0	0	0	0	0	0	0
01/02/2050 15:10	0	0	0	0	0	0	0	0	0
01/02/2050 15:15	0	0	0	0	0	0	0	0	0
01/02/2050 15:20	0	0	0	0	0	0	0	0	0
01/02/2050 15:25	0	0	0	0	0	0	0	0	0
01/02/2050 15:30	0	0	0	0	0	0	0	0	0
01/02/2050 15:35	0	0	0	0	0	0	0	0	0
01/02/2050 15:40	0	0	0	0	0	0	0	0	0
01/02/2050 15:45	0	0	0	0	0	0	0	0	0

FINAL HYDRAULIC RUN
(Staff Recommended Alternative Run)

Attached is the output for the Staff Recommended Alternative Run, which includes the BMX Park improvements by the City of San Jose and the staff recommended solutions to the flooding at Sites 3 and 4. Below is a map for the reference cross streets.



Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
59766.5	1100.0	372.3	377.7	384.3	384.0	6.6	6.2	5.4	204.7	96.1	0.7
59747.0	1100.0	372.1	377.7	383.0	384.4	5.3	6.7	4.4	249.0	98.0	0.5
59727.0	1100.0	371.9	377.6	382.8	384.3	5.2	6.7	4.8	228.2	81.2	0.5
59707.0	1100.0	371.7	377.5	382.5	384.2	5.1	6.8	5.0	218.8	72.4	0.5
59687.0	1100.0	371.5	377.3	382.2	384.1	4.9	6.8	5.2	211.4	66.7	0.5
59667.0	1100.0	371.4	377.2	382.0	384.0	4.8	6.9	5.4	202.6	62.1	0.5
59649.3	1100.0	371.2	376.7	381.9	383.7	5.3	7.0	7.1	155.3	53.2	0.7
59631.6	1100.0	371.1	376.1	381.9	383.3	5.8	7.2	8.3	132.0	47.7	0.9
59614.0	1100.0	371.0	376.1	381.8	383.0	5.8	6.9	7.2	153.5	52.6	0.7
59597.7	1100.0	370.7	375.3	381.8	381.7	6.5	6.4	8.9	124.0	52.1	1.0
59581.5	1100.0	370.6	374.6	381.9	380.5	7.3	5.9	9.5	115.9	56.9	1.2
59575.5	1100.0	368.5	375.3	381.9	380.5	6.5	5.2	5.4	202.4	62.7	0.5
59569.5	1100.0	368.4	375.3	381.9	380.5	6.6	5.2	5.5	200.6	62.4	0.5
59566.5	1100.0	369.4	374.9	381.9	380.5	7.0	5.6	7.2	153.6	58.5	0.8
59521.5	1100.0	369.0	373.9	380.5	379.9	6.6	6.0	7.4	149.3	61.2	0.8
59515.5	1100.0	367.0	374.0	380.5	379.9	6.5	5.8	5.7	194.1	60.6	0.6
59509.5	1100.0	366.9	374.0	380.5	379.9	6.6	5.9	5.8	190.3	60.3	0.6
59506.5	1100.0	367.9	373.2	380.5	379.9	7.3	6.7	8.6	128.3	56.5	1.0
59461.5	1100.0	367.6	372.6	377.0	378.2	4.4	5.6	4.7	234.8	81.5	0.5
59455.5	1100.0	365.6	372.7	377.0	378.2	4.3	5.5	3.4	322.8	82.2	0.3
59449.5	1100.0	365.5	372.6	377.0	378.2	4.4	5.6	3.4	322.4	82.1	0.3
59446.5	1100.0	366.5	372.5	377.0	378.2	4.5	5.7	4.5	246.6	81.1	0.5
59413.4	1100.0	366.2	371.0	376.3	375.5	5.3	4.6	9.5	116.2	30.5	0.9
59398.2	Bridge	**Comer**									
59382.9	1100.0	365.9	370.3	376.5	376.6	6.2	6.3	10.5	104.6	30.5	1.0
59341.5	1100.0	365.3	368.7	376.0	376.5	7.3	7.8	11.3	97.1	66.5	1.7
59335.5	1100.0	363.3	369.8	376.0	376.5	6.2	6.7	4.9	222.5	63.9	0.5
59329.5	1100.0	363.2	369.7	376.0	376.5	6.3	6.8	5.0	220.6	63.7	0.5
59326.5	1100.0	364.2	369.2	376.0	376.5	6.8	7.3	7.1	155.8	68.2	0.8
59281.5	1100.0	363.9	368.1	376.9	376.6	8.8	8.5	6.7	163.8	72.8	0.8
59275.5	1100.0	361.9	368.3	376.9	376.6	8.6	8.3	4.3	255.3	73.9	0.4
59269.5	1100.0	361.7	368.3	376.9	376.6	8.6	8.4	4.3	254.2	73.8	0.4

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
59266.5	1100.0	362.7	367.7	376.9	376.6	9.2	8.9	7.0	157.6	71.9	0.8
59221.5	1100.0	362.4	367.2	375.4	375.0	8.2	7.9	5.0	219.5	81.1	0.5
59215.6	1100.0	360.4	367.3	375.4	375.0	8.1	7.8	3.6	306.5	81.4	0.3
59209.5	1100.0	360.3	367.2	375.4	375.0	8.1	7.8	3.6	306.2	81.3	0.3
59206.5	1100.0	361.3	367.0	375.4	375.0	8.3	8.0	4.8	230.2	80.7	0.5
59051.5	1100.0	359.5	364.1	374.5	372.7	10.4	8.6	7.9	139.1	52.2	0.9
59045.5	1100.0	357.5	364.4	374.5	372.7	10.0	8.2	5.0	220.9	53.4	0.4
59039.5	1100.0	357.4	364.4	374.5	372.7	10.1	8.3	5.0	221.0	53.3	0.4
59036.5	1100.0	358.4	363.5	374.5	372.7	11.0	9.2	8.9	123.6	50.4	1.0
58991.5	1100.0	358.0	362.8	370.1	373.3	7.3	10.5	6.0	182.1	65.1	0.6
58985.5	1100.0	356.0	363.0	370.1	373.3	7.2	10.3	4.3	255.8	65.7	0.4
58979.5	1100.0	355.9	363.0	370.1	373.3	7.2	10.3	4.3	255.8	65.6	0.4
58976.5	1100.0	356.9	362.7	370.1	373.3	7.4	10.6	5.7	194.0	64.6	0.6
58911.5	1100.0	356.3	360.6	374.5	368.7	13.9	8.0	9.3	118.0	42.5	1.0
58905.5	1100.0	354.3	361.1	374.5	368.7	13.4	7.6	5.9	187.9	44.8	0.5
58899.5	1100.0	354.2	361.1	374.5	368.7	13.4	7.6	5.9	187.9	44.7	0.5
58896.5	1100.0	355.2	360.3	374.5	368.7	14.2	8.4	9.0	122.1	41.7	0.9
58851.5	1100.0	354.9	360.0	372.8	369.4	12.8	9.4	6.2	178.1	61.4	0.6
58845.5	1100.0	352.9	360.1	372.8	369.4	12.7	9.3	4.8	227.9	61.9	0.4
58839.5	1100.0	352.8	360.1	372.8	369.4	12.7	9.3	4.9	226.1	61.8	0.5
58836.5	1100.0	353.8	359.9	372.8	369.4	12.9	9.5	5.8	190.4	61.0	0.6
58793.5	1100.0	353.4	359.5	372.3	369.3	12.8	9.8	5.7	192.6	62.9	0.6
58751.7	1100.0	353.3	359.0	370.1	369.4	11.1	10.4	6.2	177.3	51.8	0.6
58737.7	1100.0	352.6	358.4	368.9	369.7	10.4	11.2	7.9	139.6	31.7	0.7
58660.0	1100.0	351.4	357.7	369.8	367.0	12.1	9.3	7.2	152.0	32.5	0.6
58617.6	1100.0	351.0	356.8	369.6	367.3	12.8	10.5	8.7	126.3	32.7	0.8
58574.5	1100.0	350.5	356.8	370.6	365.9	13.8	9.1	6.4	173.1	38.3	0.5
58540.6	1100.0	349.1	356.9	372.8	365.4	15.9	8.5	4.3	254.7	48.1	0.3
58503.9	1100.0	349.5	356.6	377.0	365.9	20.5	9.3	5.8	190.2	46.0	0.5
58477.4	1100.0	348.5	356.3	367.8	364.7	11.5	8.4	6.2	178.2	43.5	0.5
58454.6	1100.0	348.4	356.0	360.0	364.5	4.0	8.6	6.9	160.0	43.9	0.6
58394.8	1100.0	348.3	355.6	367.1	362.5	11.5	6.9	6.4	172.8	33.9	0.5

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	LOB Elev (ft)	ROB Elev (ft)	L. Frbrd (ft)	R. Frbrd (ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
58340.6	1100.0	347.4	354.8	367.1	362.5	12.2	7.7	8.0	138.3	30.1	0.7
58328.4	1100.0	347.7	355.0	366.7	362.4	11.8	7.4	6.4	172.1	33.6	0.5
58287.2	1100.0	347.5	354.8	366.2	362.0	11.5	7.2	6.1	181.7	36.8	0.5
58181.2	1100.0	346.1	353.3	364.2	360.7	10.9	7.4	8.1	135.9	30.9	0.7
58087.5	1100.0	345.6	352.6	366.2	359.0	13.6	6.4	6.7	165.3	33.9	0.5
58073.2	1100.0	344.7	352.6	365.7	359.0	13.1	6.4	6.4	172.3	35.9	0.5
57999.3	1100.0	344.9	351.9	365.4	358.9	13.5	7.0	6.7	163.3	33.3	0.5
57958.2	1100.0	344.4	351.4	360.9	358.9	9.5	7.5	7.4	148.4	31.5	0.6
57906.5	1100.0	344.0	350.6	357.8	359.2	7.2	8.6	8.3	131.9	28.8	0.7
57813.2	1100.0	342.8	350.1	356.4	358.9	6.3	8.8	6.1	181.5	38.9	0.5
57713.8	1100.0	342.2	349.1	353.9	362.2	4.8	13.1	7.1	154.9	34.4	0.6
57634.7	1100.0	341.4	348.0	358.3	358.2	10.4	10.2	8.2	134.6	31.9	0.7
57609.9	1100.0	340.7	347.8	353.4	363.8	5.6	16.1	8.1	135.6	32.6	0.7
57569.6	1100.0	340.0	346.4	352.7	362.9	6.3	16.5	10.9	101.2	27.8	1.0
57507.7	1100.0	339.6	346.0	353.0	362.0	7.0	16.0	7.5	147.1	33.7	0.6
57416.5	1100.0	338.9	345.4	350.6	353.7	5.1	8.3	7.7	142.9	33.7	0.7
57363.3	1100.0	338.2	345.1	349.8	352.3	4.7	7.3	7.6	144.2	37.3	0.7
57277.2	1100.0	337.7	343.0	348.0	350.1	5.0	7.1	11.5	95.9	23.7	1.0
57236.6	1100.0	337.4	341.5	347.9	349.8	6.5	8.3	13.3	82.6	24.3	1.3
57235.9	1100.0	337.4	341.4	347.9	349.7	6.5	8.2	13.3	82.6	24.4	1.3
57235.8	1100.0	334.7	342.6	347.9	349.7	5.3	7.1	7.2	152.9	26.6	0.5
57173.4	1100.0	335.2	342.4	347.3	349.5	4.8	7.1	7.0	157.5	30.0	0.5
57140.8	1100.0	335.6	341.3	348.1	348.0	6.8	6.7	10.5	105.2	20.0	0.8
57128.7	Bridge	**Wardell**									
57116.5	1100.0	335.1	341.3	348.0	348.2	6.8	6.9	10.4	106.0	20.0	0.8
57077.0	1100.0	334.2	341.3	345.5	345.3	4.2	4.0	9.2	119.7	24.5	0.7
57073.9	1100.0	334.4	340.5	345.9	346.0	5.4	5.5	11.4	96.4	23.9	1.0
57065.4	1100.0	331.4	335.8	345.0	345.3	9.2	9.5	19.6	56.3	19.2	2.0
57017.4	1100.0	332.1	339.3	344.2	343.6	4.8	4.3	7.7	143.7	25.6	0.6
56987.0	1100.0	331.7	339.3	344.0	343.6	4.7	4.3	6.7	164.4	27.7	0.5
56921.2	1100.0	330.6	338.8	343.1	342.9	4.2	4.0	7.0	156.7	28.0	0.5
56825.7	1100.0	330.5	338.2	343.1	341.8	5.0	3.6	7.4	149.5	24.8	0.5

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
56730.0	1100.0	330.0	337.4	342.0	341.0	4.6	3.6	7.5	146.1	25.9	0.6
56631.9	1100.0	329.1	336.8	340.0	339.5	3.1	2.6	7.0	157.1	27.2	0.5
56536.8	1100.0	328.4	336.1	338.3	337.6	2.2	1.6	7.3	150.0	28.9	0.6
56440.7	1100.0	327.6	335.0	337.2	335.9	2.2	0.8	8.1	136.0	25.6	0.6
56413.5	1100.0	327.3	334.6	336.4	335.8	1.8	1.3	9.0	122.6	24.0	0.7
56348.1	1100.0	327.2	334.1	335.5	336.1	1.5	2.0	8.9	123.4	25.2	0.7
56336.7	1100.0	327.2	334.3	336.0	335.4	1.7	1.1	7.4	148.8	30.5	0.6
56297.8	1100.0	326.5	334.1	335.8	335.4	1.6	1.3	6.5	168.4	33.9	0.5
56264.1	1100.0	326.9	333.9	339.0	338.0	5.1	4.1	6.7	165.1	35.8	0.6
56196.3	1100.0	326.1	333.4	334.0	333.4	0.6	0.0	6.8	163.1	40.5	0.6
56182.9	1100.0	325.9	333.3	333.8	333.7	0.5	0.4	6.6	165.9	37.5	0.6
56160.7	1100.0	326.4	332.6	335.1	335.2	2.4	2.6	8.5	129.9	28.5	0.7
56119.3	1100.0	325.4	332.6	332.7	333.0	0.1	0.4	6.7	164.7	39.5	0.6
56074.2	1100.0	324.9	331.5	332.7	333.2	1.2	1.7	9.2	119.7	25.6	0.8
56068.6	1100.0	324.8	331.8	332.6	333.4	0.8	1.6	7.7	142.8	28.7	0.6
56054.6	1100.0	325.0	331.8	332.6	333.4	0.9	1.6	7.2	153.8	29.6	0.6
56045.3	1100.0	324.5	331.5	332.2	333.4	0.7	1.9	8.1	136.3	24.9	0.6
55979.4	1100.0	322.6	329.8	332.5	332.0	2.7	2.2	11.0	99.9	22.6	0.9
55943.1	1100.0	322.0	330.3	331.6	332.8	1.3	2.5	7.1	155.5	27.9	0.5
55879.7	1100.0	322.0	329.8	331.8	335.4	2.0	5.6	7.5	146.5	25.5	0.6
55796.1	1100.0	321.2	329.2	332.3	330.8	3.1	1.5	7.7	142.6	25.2	0.6
55710.2	1100.0	321.1	328.3	329.7	330.2	1.4	2.0	8.9	123.8	24.1	0.7
55666.4	1100.0	320.5	328.4	330.2	329.6	1.9	1.2	6.6	166.2	28.8	0.5
55620.8	1100.0	320.4	328.0	330.2	329.7	2.2	1.7	7.4	149.2	30.8	0.6
55527.6	1100.0	319.4	327.3	327.6	328.0	0.3	0.8	7.6	144.9	42.8	0.6
55469.5	1100.0	319.2	327.2	327.2	328.1	0.0	0.9	5.5	206.6	63.1	0.5
55434.9	1100.0	319.3	326.9	327.0	327.1	0.1	0.2	5.8	189.6	45.5	0.5
55340.2	1100.0	318.5	326.2	328.1	326.8	1.9	0.6	6.9	159.5	39.1	0.6
55246.1	1100.0	317.9	324.7	327.7	327.0	3.1	2.4	9.1	120.7	26.2	0.8
55160.6	1100.0	317.4	323.9	325.4	325.4	1.5	1.5	8.4	131.4	29.8	0.7
55059.3	1100.0	316.8	323.0	324.0	323.9	1.0	0.9	8.2	133.9	28.0	0.7
55022.7	1100.0	315.8	322.8	324.4	323.6	1.6	0.8	7.5	146.6	33.7	0.6

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	LOB Elev (ft)	ROB Elev (ft)	L. Frbrd (ft)	R. Frbrd (ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
54980.2	1100.0	315.7	321.9	322.9	322.6	1.1	0.8	9.4	117.2	28.3	0.8
54972.5	1100.0	315.7	322.0	322.9	322.4	0.9	0.5	8.4	130.7	27.3	0.7
54953.8	1100.0	315.4	322.1	322.7	322.4	0.5	0.3	6.3	174.5	69.3	0.7
54940.6	1100.0	315.2	321.5	322.8	322.1	1.2	0.6	8.0	137.7	46.0	0.8
54929.6	1100.0	314.9	320.4	322.0	322.1	1.6	1.7	11.0	99.9	26.4	1.0
54905.6	1100.0	314.4	319.2	321.3	321.4	2.1	2.2	12.4	88.4	31.7	1.3
54864.0	1100.0	313.6	318.6	322.4	322.4	3.8	3.8	11.3	97.5	20.0	0.9
54863.0	1100.0	313.6	318.6	322.4	322.4	3.8	3.8	11.3	97.3	20.0	0.9
54845.5	Bridge	**UPRR**									
54828.0	1100.0	313.1	318.8	321.7	321.7	2.9	2.9	9.9	110.8	20.0	0.7
54827.0	1100.0	313.1	318.8	321.7	321.7	3.0	3.0	9.9	110.6	20.0	0.8
54824.0	1100.0	313.0	319.0	320.7	320.5	1.8	1.6	8.4	131.3	24.2	0.6
54809.7	1100.0	312.7	317.9	320.7	320.5	2.8	2.6	11.1	99.1	23.1	1.0
54768.7	1100.0	311.1	318.3	319.6	320.0	1.4	1.8	7.8	140.7	35.6	0.7
54735.4	1100.0	311.4	318.3	318.4	319.8	0.1	1.5	6.3	179.3	62.1	0.5
54714.6	1100.0	310.7	318.2	318.3	319.7	0.1	1.5	6.0	184.9	58.9	0.6
54705.1	1100.0	310.5	318.3	319.0	319.7	0.7	1.5	5.1	217.3	59.3	0.5
54705.0	1100.0	310.5	318.3	319.0	319.7	0.7	1.5	5.1	217.3	59.3	0.5
54693.8	1100.0	310.9	318.3	319.0	319.6	0.7	1.3	4.7	233.0	60.0	0.4
54653.0	1100.0	310.4	318.2	318.5	318.6	0.3	0.4	4.2	262.0	118.5	0.3
54641.0	1100.0	309.8	318.3	321.5	320.0	3.2	1.7	1.9	595.1	103.5	0.1
54618.0	1400.0	309.5	317.6	318.1	319.5	0.5	1.9	6.5	217.1	78.7	0.5
54534.0	1400.0	308.2	317.0	319.0	317.4	2.0	0.4	7.0	199.6	77.8	0.5
54532.0	**Lat Struct**										
54449.0	1378.2	307.7	316.0	318.9	318.3	2.9	2.3	8.2	168.8	61.4	0.6
54373.0	1345.5	307.1	315.5	318.2	317.1	2.8	1.7	7.1	189.9	126.1	0.6
54276.0	1338.2	306.5	314.6	316.7	318.0	2.1	3.4	7.4	180.3	64.2	0.6
54176.0	1338.2	306.1	313.0	315.9	317.9	2.9	4.9	9.2	146.2	56.4	0.8
54077.0	1338.2	304.9	312.0	313.7	315.9	1.7	3.9	7.8	170.9	53.4	0.6
53988.0	1338.2	303.9	311.5	313.0	314.8	1.5	3.2	6.6	204.2	67.4	0.5
53883.0	1338.2	303.8	310.8	310.9	313.7	0.1	2.9	6.4	209.8	69.6	0.5
53789.0	1338.2	302.7	310.0	312.3	312.5	2.4	2.6	7.0	190.9	67.6	0.6

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
53687.0	1338.2	301.7	309.3	310.6	312.9	1.3	3.6	6.4	209.4	70.0	0.5
53590.0	1338.2	300.8	308.3	309.1	308.3	0.8	0.0	7.6	177.0	99.8	0.6
53491.0	1338.2	300.6	307.7	308.9	311.3	1.2	3.6	6.1	219.6	79.6	0.5
53473.0	1338.2	300.5	307.6	308.6	311.6	1.0	4.0	6.0	224.9	80.5	0.5
53395.0	1338.2	299.1	306.7	307.5	309.2	0.8	2.5	8.3	162.2	69.3	0.7
53394.0	Lat Struct										
53301.0	1338.2	297.9	306.5	307.2	310.1	0.7	3.6	6.4	208.0	47.3	0.5
53210.0	1338.2	296.4	306.0	306.9	308.3	0.9	2.3	7.3	182.7	36.9	0.6
53194.2	1338.2	296.2	305.4	306.2	306.2	0.9	0.9	9.2	146.1	16.0	0.5
53194.0	1338.2	296.2	305.4	306.2	306.2	0.9	0.9	9.2	146.1	16.0	0.5
53122.0	1338.2	295.4	305.4	305.4	305.4	0.0	0.0	8.3	160.4	16.0	0.5
53114.0	1338.2	295.3	302.6	304.3	304.3	1.7	1.7	15.4	87.2	12.0	1.0
53057.1	1338.2	294.8	301.6	303.7	303.6	2.1	2.0	16.5	81.0	12.0	1.1
53056.5	1338.2	294.8	301.6	304.0	303.9	2.4	2.2	16.5	81.1	12.0	1.1
53008.4	1338.2	294.4	300.6	303.5	303.5	2.9	2.9	17.7	75.7	12.3	1.3
52921.9	1338.2	293.7	300.0	302.7	302.7	2.7	2.8	17.8	75.3	12.1	1.3
52910.0	1338.2	293.5	299.7	302.6	302.6	2.8	2.8	18.0	74.5	12.1	1.3
52725.2	1338.2	291.6	297.4	300.8	300.7	3.4	3.3	19.3	69.3	12.1	1.4
52716.1	1338.2	291.5	297.3	300.4	300.4	3.1	3.1	19.3	69.4	12.1	1.4
52711.2	1338.2	291.5	297.4	300.5	300.5	3.0	3.1	18.8	71.1	12.1	1.4
52700.0	1338.2	291.4	297.3	300.5	300.5	3.1	3.2	18.9	70.9	12.1	1.4
52511.2	1338.2	290.8	297.9	301.0	300.7	3.0	2.8	15.2	88.3	12.5	1.0
52484.8	1408.2	291.3	295.4	300.5	300.5	5.1	5.1	18.9	74.7	24.9	1.9
52482.6	1408.2	291.3	295.1	301.0	300.9	6.0	5.8	19.1	73.6	26.5	2.0
52378.2	1408.2	290.5	297.3	301.2	300.7	4.0	3.4	8.0	175.3	35.1	0.6
52272.3	1408.2	289.6	295.7	300.3	300.7	4.6	5.0	9.8	143.3	32.5	0.8
52163.4	1408.2	287.7	294.9	300.5	300.5	5.6	5.7	8.0	176.4	35.1	0.6
52112.7	1408.2	287.4	293.8	300.9	300.2	7.1	6.5	9.8	143.8	30.1	0.8
52109.1	1408.2	284.8	294.3	300.6	300.3	6.3	6.0	6.8	206.8	31.6	0.5
52108.6	1408.2	285.2	294.3	300.7	299.9	6.5	5.6	6.9	203.2	31.7	0.5
52092.9	1408.2	285.8	294.2	300.1	300.2	5.8	6.0	6.6	213.4	34.6	0.5
52079.9	1408.2	284.9	294.2	299.4	299.1	5.2	4.8	6.3	225.4	37.1	0.5

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
52079.8	1408.2	284.9	294.2	299.4	299.1	5.2	4.8	6.3	225.4	37.1	0.5
51957.0	1408.2	283.9	293.1	299.5	294.1	6.4	1.1	6.4	220.3	77.4	0.5
51859.9	1408.2	283.3	291.7	294.8	294.1	3.1	2.4	6.1	232.9	126.1	0.6
51749.2	1408.2	282.7	290.4	294.7	293.4	4.3	3.1	5.2	269.1	99.1	0.6
51649.3	1408.2	282.3	289.7	294.2	292.9	4.5	3.2	4.8	296.7	84.0	0.4
51630.9	1408.2	282.3	289.3	293.3	292.9	4.0	3.6	6.4	220.2	58.3	0.6
51546.6	1408.2	281.9	289.0	292.4	292.4	3.4	3.4	4.1	340.6	106.2	0.4
51443.1	1408.2	280.5	288.5	289.9	292.6	1.4	4.1	4.5	315.7	90.1	0.4
51344.8	1408.2	279.3	287.2	289.8	292.3	2.7	5.1	7.1	199.6	79.7	0.8
51259.2	1408.2	279.1	285.8	288.9	289.0	3.0	3.2	6.3	223.5	100.6	0.8
51197.0	1478.2	278.0	284.0	295.5	295.2	11.6	11.3	9.2	159.9	41.9	0.8
51184.6	1478.2	278.5	284.1	293.9	293.4	9.8	9.4	8.1	183.3	50.6	0.8
51098.1	Bridge	**SR 85**									
51011.6	1478.2	278.5	283.0	293.9	293.4	10.8	10.4	11.3	131.3	50.5	1.2
50944.6	1478.2	277.1	282.8	293.9	293.4	11.0	10.6	8.5	174.8	44.3	0.8
50863.1	Bridge	**SR 85**									
50781.6	1478.2	277.1	281.6	293.9	293.4	12.3	11.9	12.2	121.6	40.2	1.2
50747.6	1478.2	275.6	279.6	293.9	293.4	14.3	13.9	14.5	101.6	36.7	1.5
50720.1	Bridge	**SR 85**									
50692.6	1478.2	275.6	280.0	293.9	293.4	13.8	13.4	12.5	118.6	37.8	1.2
50688.3	1478.2	275.6	280.1	290.1	292.2	10.0	12.1	12.1	122.1	38.2	1.2
50595.8	1478.2	273.6	280.5	292.0	285.5	11.5	4.9	5.7	260.2	59.6	0.5
50496.3	1478.2	272.4	280.6	284.1	283.5	3.6	3.0	2.6	577.9	100.1	0.2
50434.8	1478.2	270.7	280.3	284.4	283.7	4.1	3.4	4.1	359.7	59.2	0.3
50335.3	1478.2	270.7	279.5	282.7	282.7	3.2	3.1	6.0	245.4	45.4	0.5
50241.0	1478.2	269.9	278.8	282.7	280.9	3.8	2.1	4.6	319.5	145.1	0.6
50236.0	1478.2	269.9	278.7	282.5	280.8	3.7	2.0	4.8	309.2	160.0	0.6
50179.3	1478.2	269.1	278.5	281.5	280.3	3.0	1.9	3.9	376.5	158.5	0.5
50142.7	1478.2	268.3	278.2	280.7	281.2	2.5	3.0	4.8	307.7	138.0	0.6
50139.4	Bridge	**Foot bridge**									
50136.1	1478.2	268.8	277.1	280.8	281.1	3.7	4.0	6.7	219.8	42.9	0.5
50030.0	1478.2	268.9	276.7	280.0	281.4	3.4	4.7	4.6	320.9	144.3	0.5

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
50029.9	1478.2	268.9	276.7	280.0	281.4	3.4	4.7	4.6	320.8	144.3	0.5
49931.2	1478.2	268.2	276.4	278.3	280.4	2.0	4.0	3.2	466.7	155.0	0.3
49931.1	1478.2	268.2	276.4	278.3	280.4	2.0	4.0	3.2	466.6	155.0	0.3
49836.1	1478.2	267.0	275.8	278.4	279.4	2.6	3.5	4.2	356.5	86.2	0.4
49755.3	1478.2	267.4	275.5	278.3	276.7	2.8	1.2	4.0	374.7	85.5	0.3
49663.4	1478.2	265.8	275.1	277.3	275.7	2.2	0.6	4.5	332.3	62.5	0.3
49564.6	1478.2	265.1	274.6	278.0	275.5	3.4	0.9	5.0	296.3	55.8	0.4
49455.8	1478.2	264.4	271.2	274.7	274.9	3.6	3.8	11.8	125.1	28.7	1.0
49455.7	1478.2	264.4	271.1	274.7	274.9	3.6	3.8	11.9	124.6	28.7	1.0
49444.9	1478.2	265.0	270.5	276.3	275.2	5.8	4.7	12.9	114.4	29.6	1.2
49444.8	1478.2	265.0	270.5	276.3	275.2	5.8	4.7	12.9	114.4	29.6	1.2
49423.7	1478.2	264.2	268.3	273.9	274.3	5.6	6.0	17.1	86.6	27.1	1.7
49410.6	1478.2	262.4	265.9	274.9	275.0	9.0	9.0	20.5	72.1	23.6	2.1
49396.5	1478.2	260.6	265.4	273.3	273.2	7.9	7.8	21.0	70.5	26.0	2.2
49341.9	Bridge	**Rainbow**									
49287.3	1478.2	260.2	265.0	272.8	274.4	7.8	9.4	18.3	80.9	28.0	1.9
49269.4	1478.2	260.0	268.3	274.2	275.2	5.9	6.9	7.4	198.9	32.0	0.5
49258.6	1478.2	260.0	268.6	273.9	274.9	5.4	6.4	5.5	271.2	42.6	0.4
49247.6	1478.2	259.4	268.6	273.9	274.3	5.3	5.7	5.3	279.1	43.6	0.4
49239.8	1478.2	259.0	268.6	273.8	274.7	5.2	6.1	5.1	290.5	43.0	0.3
49239.7	1478.2	259.0	268.6	273.8	274.7	5.2	6.1	5.1	290.5	43.0	0.3
49226.4	1478.2	257.9	268.6	273.6	274.6	5.0	6.0	5.0	297.0	41.3	0.3
49181.6	1538.2	259.7	266.4	273.2	273.1	6.9	6.8	12.2	125.9	26.8	1.0
49181.5	1538.2	259.7	266.3	273.2	273.1	6.9	6.8	12.4	124.6	26.5	1.0
49179.8	1538.2	258.1	263.7	273.4	273.5	9.7	9.8	17.3	88.8	21.8	1.5
49171.8	1538.2	258.4	262.4	273.2	272.8	10.8	10.5	19.1	80.7	24.8	1.9
49073.0	1538.2	257.5	265.7	273.1	269.5	7.4	3.9	7.9	194.8	37.0	0.6
49072.9	1538.2	257.5	265.7	273.1	269.5	7.4	3.9	7.9	194.8	37.0	0.6
49032.0	1538.2	256.9	265.8	272.7	268.9	6.9	3.1	5.9	262.5	45.5	0.4
48973.7	1538.2	256.6	265.6	271.5	268.1	5.9	2.5	5.8	264.8	46.9	0.4
48872.7	1538.2	255.6	265.3	271.3	266.0	6.0	0.8	5.8	266.6	49.1	0.4
48772.5	1538.2	254.9	265.1	269.9	265.7	4.9	0.6	4.3	362.1	81.4	0.4

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
48677.5	1538.2	253.9	264.5	270.9	265.2	6.4	0.7	5.6	274.7	62.8	0.4
48580.6	1538.2	253.5	262.4	269.3	265.6	6.9	3.3	10.7	143.9	20.0	0.7
48482.0	1538.2	253.0	262.3	267.5	264.4	5.2	2.2	6.7	231.4	37.4	0.5
48380.5	1538.2	252.5	261.3	267.1	263.5	5.8	2.3	8.0	191.3	34.2	0.6
48280.5	1538.2	252.2	261.0	265.9	262.9	4.9	2.0	6.5	237.8	37.7	0.5
48181.1	1538.2	251.3	260.4	265.1	262.9	4.7	2.4	6.8	226.9	39.8	0.5
48080.7	1538.2	251.0	258.9	265.3	262.8	6.4	3.9	9.7	159.5	29.7	0.7
47980.4	1538.2	250.7	257.5	263.3	261.6	5.8	4.1	10.1	151.7	33.1	0.8
47885.3	1538.2	250.2	257.0	261.3	261.1	4.3	4.0	7.7	199.8	41.3	0.6
47885.2	1538.2	250.2	257.0	261.3	261.1	4.3	4.0	7.7	199.8	41.3	0.6
47874.4	1538.2	250.6	255.8	260.5	260.7	4.7	4.8	11.2	137.2	34.8	1.0
47874.3	1538.2	250.7	255.3	261.5	260.8	6.2	5.6	12.6	122.0	33.4	1.2
47843.3	1538.2	247.1	250.2	260.5	260.4	10.3	10.2	21.1	72.8	29.7	2.4
47828.9	1538.2	246.9	250.4	259.4	260.5	9.0	10.1	20.2	76.2	22.0	1.9
47794.4	Bridge	**Blaney**									
47765.9	1538.2	246.8	253.4	259.4	259.4	5.9	5.9	9.3	166.0	25.0	0.6
47736.0	1538.2	246.6	252.2	255.9	261.4	3.6	9.2	12.0	128.5	29.0	1.0
47717.8	1538.2	244.0	248.4	259.2	261.2	10.8	12.8	19.1	80.8	25.2	1.9
47681.0	1538.2	243.2	246.8	259.5	261.4	12.7	14.6	20.8	73.9	32.0	2.4
47654.7	1538.2	243.3	247.2	259.6	261.4	12.5	14.3	18.0	85.4	33.4	2.0
47606.0	1538.2	243.4	250.9	260.3	259.9	9.3	9.0	3.4	456.3	93.4	0.3
47517.4	1538.2	241.9	250.5	258.8	258.0	8.2	7.4	5.2	296.3	48.9	0.4
47422.5	1938.2	240.4	249.2	258.7	257.9	9.5	8.7	9.1	214.0	30.3	0.6
47327.2	1938.2	239.4	248.6	256.2	257.0	7.6	8.4	8.3	234.9	38.2	0.6
47230.6	1938.2	238.7	248.2	254.5	256.9	6.3	8.8	7.5	259.3	37.4	0.5
47134.2	1938.2	237.2	247.5	254.7	255.9	7.2	8.4	7.8	249.6	38.1	0.5
47033.1	1938.2	237.9	246.5	254.0	255.5	7.5	9.0	8.0	243.4	52.3	0.7
46934.8	1938.2	237.6	246.1	253.2	254.3	7.1	8.2	5.6	345.7	87.9	0.5
46891.9*	1938.2	237.2	245.9	253.0	254.5	7.1	8.6	5.5	353.6	78.5	0.5
46849.0*	1938.2	236.8	245.7	252.7	254.7	7.0	9.0	5.6	349.0	85.6	0.5
46806.2	1938.2	236.5	245.7	252.5	254.9	6.7	9.2	3.9	492.8	110.5	0.3
46696.8	1938.2	235.0	245.3	251.3	254.1	6.0	8.8	5.3	367.1	53.0	0.4

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
46616.2	1938.2	235.1	244.9	249.9	252.9	5.0	8.0	6.1	317.2	44.4	0.4
46518.4	1938.2	234.7	244.3	251.8	251.9	7.4	7.6	6.8	284.6	47.0	0.5
46419.6	1938.2	234.5	243.8	250.1	251.3	6.3	7.5	6.6	295.4	46.6	0.5
46319.0	1938.2	234.1	243.4	251.7	250.4	8.4	7.1	6.4	300.9	53.6	0.5
46219.3	1938.2	233.4	242.7	250.7	249.7	8.0	7.0	6.9	282.2	50.8	0.5
46120.1	1938.2	231.9	242.4	250.2	248.8	7.8	6.4	5.5	352.5	63.3	0.4
46062.0	1938.2	233.5	242.2	249.3	248.4	7.0	6.1	5.2	369.7	57.1	0.4
46026.0	1938.2	232.1	242.0	248.7	248.8	6.7	6.8	5.7	339.5	57.7	0.4
45925.6	1938.2	232.1	241.1	248.0	247.6	6.9	6.5	7.6	255.5	49.7	0.6
45825.9	1938.2	231.3	240.8	245.5	246.7	4.7	5.9	5.4	356.2	79.2	0.5
45727.7	1938.2	230.6	240.5	243.4	247.8	2.9	7.3	4.9	392.4	79.3	0.4
45637.3	1938.2	230.1	239.9	242.0	246.5	2.1	6.6	6.3	306.0	48.8	0.5
45533.0	1938.2	229.9	239.2	241.6	245.0	2.4	5.8	7.1	274.3	53.1	0.6
45435.8	1938.2	230.0	238.8	240.6	243.9	1.9	5.2	6.7	290.3	50.2	0.5
45339.6	1938.2	229.0	238.1	240.7	242.4	2.6	4.3	6.9	279.5	60.1	0.6
45233.2	1938.2	228.0	237.6	239.5	242.1	1.9	4.5	6.5	299.9	53.3	0.5
45165.0	1938.2	227.6	237.1	239.0	242.8	2.0	5.7	7.0	275.3	62.4	0.6
45140.0	1938.2	227.3	237.0	239.2	242.7	2.1	5.6	6.3	306.1	55.7	0.5
45115.0	1938.2	226.8	236.5	241.8	242.7	5.2	6.1	8.0	243.4	33.4	0.5
45090.0	1938.2	226.8	235.7	241.4	242.6	5.7	6.9	10.3	187.9	29.9	0.7
45065.0	1938.2	227.3	235.9	239.0	242.8	3.1	6.8	8.3	234.9	42.0	0.6
44931.5	1938.2	226.2	233.5	241.0	238.5	7.5	5.0	12.3	157.1	33.4	1.0
44825.0	1938.2	225.5	230.7	236.7	240.8	6.0	10.2	15.3	126.9	36.2	1.4
44814.0	1938.2	225.5	229.7	236.6	240.1	6.9	10.4	16.7	116.2	35.1	1.6
44810.0	1938.2	225.5	229.9	236.6	240.1	6.7	10.2	15.5	124.7	35.9	1.5
44809.9	1938.2	223.5	231.8	236.6	240.1	4.8	8.3	7.1	273.5	45.5	0.5
44762.5	1938.2	221.5	232.0	235.4	239.7	3.4	7.7	5.2	376.4	51.6	0.3
44745.0	1938.2	220.8	231.8	235.3	239.2	3.5	7.4	6.3	309.6	35.7	0.4
44740.3	1938.2	220.6	231.6	234.8	235.5	3.3	3.9	7.2	268.5	30.4	0.4
44740.2	1938.2	222.6	231.0	234.8	235.5	3.8	4.5	9.3	209.5	29.6	0.6
44740.1	1938.2	222.6	231.0	234.8	235.5	3.8	4.5	9.3	209.5	29.6	0.6
44740.0	1938.2	220.5	231.4	234.8	235.5	3.5	4.1	7.4	262.9	30.1	0.4

Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
44732.0	1938.2	220.3	231.0	234.9	235.5	3.8	4.5	8.6	225.8	23.4	0.5
44731.0	1938.2	220.3	230.5	237.2	237.9	6.7	7.4	10.2	189.6	18.6	0.6
44699.4	1938.2	219.3	230.7	237.2	237.9	6.5	7.2	9.2	210.8	18.6	0.5
44699.3	1938.2	221.3	228.3	237.2	237.9	8.9	9.6	15.0	129.3	18.5	1.0
44698.3	1938.2	221.2	227.9	237.2	237.9	9.2	9.9	15.6	124.1	18.5	1.1
44698.2	1938.2	219.2	224.1	237.2	237.9	13.1	13.8	21.7	89.3	18.5	1.7
44638.3	1938.2	216.1	229.3	237.2	237.9	7.9	8.6	8.0	243.6	18.6	0.4
44638.2	1938.2	219.6	226.5	237.2	237.9	10.6	11.3	15.0	129.4	18.5	1.0
44637.2	1938.2	219.6	226.5	237.2	237.9	10.6	11.3	15.0	129.3	18.5	1.0
44637.0	1938.2	216.1	220.4	237.2	237.9	16.7	17.4	24.1	80.4	18.5	2.0
44636.5	1938.2	212.3	215.9	235.2	238.3	19.3	22.4	29.1	66.7	21.9	2.9
44635.0	2038.2	212.3	216.1	235.2	238.3	19.0	22.2	28.6	71.3	22.3	2.8
44572.5	2038.2	212.3	222.8	234.9	237.3	12.1	14.5	6.8	302.1	50.5	0.5
44570.0	2038.2	215.0	222.2	234.9	237.3	12.7	15.1	8.9	228.7	49.6	0.7
44525.0	2038.2	214.7	220.7	237.3	237.5	16.5	16.7	12.4	163.9	35.2	1.0
44488.0	2038.2	213.6	221.2	238.1	237.7	16.9	16.5	8.9	229.5	39.1	0.7
44288.0	2038.2	211.7	220.3	237.2	236.2	16.9	15.9	8.3	245.8	39.2	0.6
44186.0	2038.2	211.2	219.5	235.8	235.8	16.3	16.3	9.3	219.6	36.2	0.7
44086.0	2038.2	210.5	218.9	234.1	234.7	15.1	15.7	9.1	224.0	34.7	0.6
43589.0	2038.2	208.7	218.1	229.5	231.5	11.3	13.3	5.6	367.3	50.5	0.4
43561.3	2038.2	208.2	217.7	228.5	231.2	10.8	13.5	7.2	281.5	42.1	0.5
43455.5	2038.2	207.7	217.3	224.6	230.3	7.3	13.0	6.4	318.4	51.8	0.5
43359.0	2038.2	207.6	217.1	228.8	230.0	11.7	12.9	5.6	365.6	55.2	0.4
43269.9	2038.2	206.1	216.5	227.8	227.7	11.4	11.2	7.1	289.1	46.3	0.5
43185.1	2038.2	206.5	216.2	227.8	226.8	11.6	10.6	6.5	316.0	51.6	0.5
43082.0	2038.2	205.7	215.6	227.1	226.8	11.5	11.2	7.3	278.1	40.3	0.5
42976.3	2038.2	205.5	215.0	226.5	225.8	11.6	10.8	7.8	260.9	39.6	0.5
42883.3	2038.2	204.7	214.8	225.3	224.1	10.4	9.3	6.1	333.8	44.1	0.4
42783.0	2038.2	204.5	214.2	225.2	224.2	11.0	10.0	6.5	313.8	45.9	0.4
42687.4	2038.2	203.6	213.4	224.7	223.0	11.3	9.7	7.7	263.3	42.0	0.5
42589.0	2038.2	203.8	213.2	223.4	223.2	10.2	10.1	6.7	306.2	45.6	0.5
42490.7	2038.2	203.0	212.9	223.4	222.1	10.6	9.3	6.3	321.4	49.9	0.4

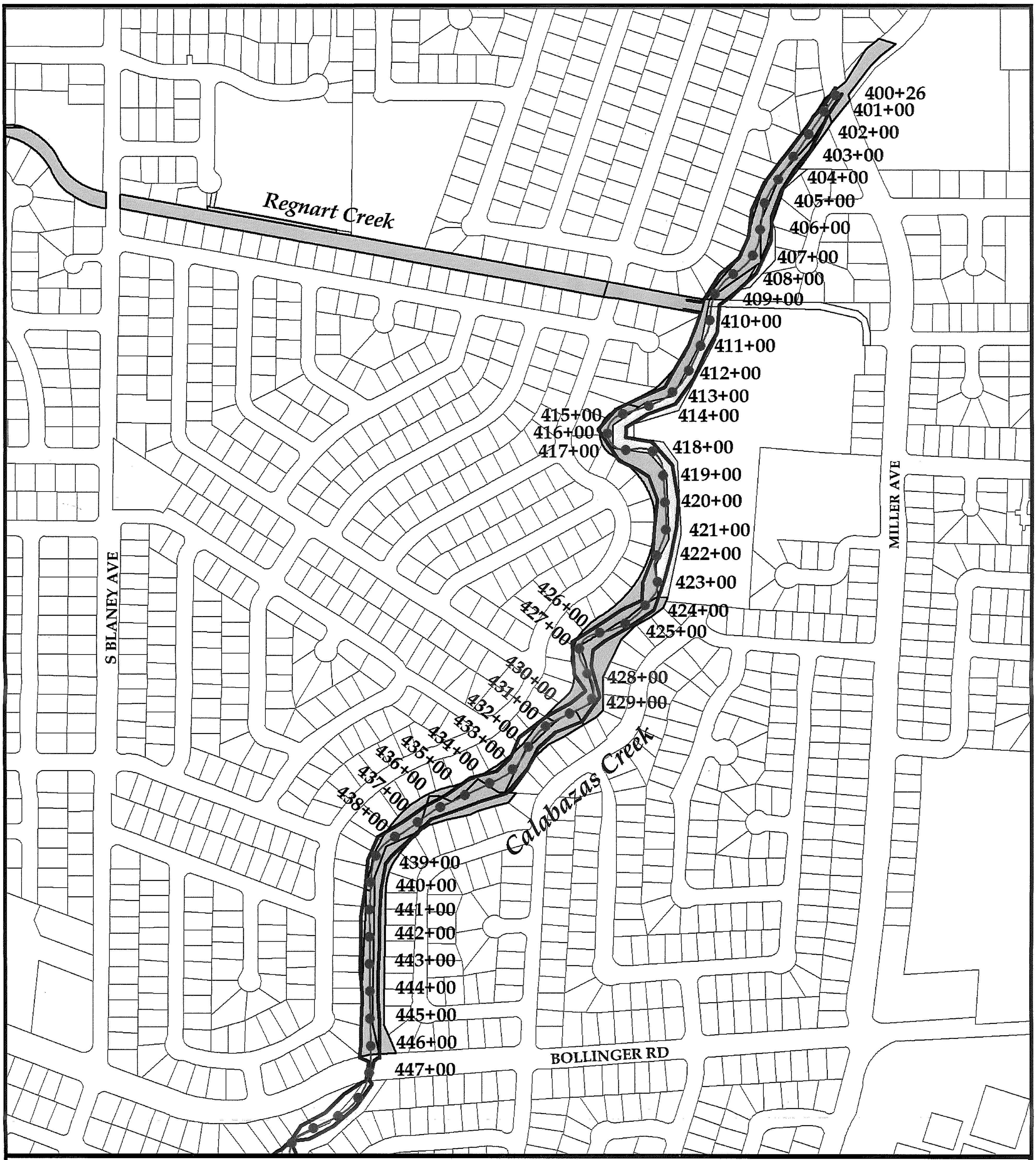
Calabazas Creek Staff Recommended Alternative (SRA) Final Hydraulic Run

River Sta	Q Total	Min Ch El	W.S. Elev	LOB Elev	ROB Elev	L. Frbrd	R. Frbrd	Vel Chnl	Flow Area	Top Width	Froude # Chl
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)	(ft)	
42393.2	2038.2	202.7	212.4	218.8	221.2	6.4	8.9	7.0	292.2	41.5	0.5
42294.9	2038.2	201.2	212.3	222.2	222.1	10.0	9.9	6.0	341.8	60.6	0.4
42248.4*	2038.2	201.1	211.5	221.6	222.1	10.1	10.6	8.5	238.5	45.3	0.7
42201.9	2038.2	201.0	211.5	220.9	222.0	9.5	10.5	7.7	264.8	39.9	0.5
42090.4	2038.2	200.6	211.2	219.8	221.5	8.7	10.3	6.6	307.0	50.3	0.5
41991.5	2038.2	201.1	210.3	220.1	220.8	9.8	10.5	7.7	266.4	42.8	0.5
41880.3	2038.2	200.7	209.9	214.7	220.0	4.8	10.2	5.9	344.6	65.3	0.5
41832.4*	2038.2	200.3	209.5	216.2	219.5	6.7	10.1	6.7	306.3	54.9	0.5
41784.6	2038.2	199.9	209.4	217.7	219.0	8.4	9.7	5.8	351.9	56.4	0.4
41683.4	2038.2	199.0	209.2	218.8	215.5	9.6	6.3	4.7	436.2	69.8	0.3
41588.7	2038.2	199.2	208.6	217.5	218.8	8.9	10.3	6.2	327.8	56.7	0.5
41541.8	2038.2	198.4	208.4	216.8	218.3	8.4	9.9	6.1	335.4	61.4	0.5
41514.9	2038.2	197.4	208.1	217.0	217.8	8.9	9.6	7.0	291.9	52.4	0.5
41439.0	2038.2	197.9	208.0	215.8	218.5	7.8	10.5	6.0	339.7	48.9	0.4
41417.5	2038.2	197.7	207.9	215.7	217.8	7.8	10.0	6.5	313.4	45.6	0.4
41311.9	2038.2	197.4	207.5	215.5	216.9	8.0	9.4	6.5	312.4	47.5	0.5
41214.6	2038.2	196.8	207.2	215.3	216.0	8.1	8.8	5.9	347.6	59.1	0.4
41118.9	2038.2	196.4	206.5	214.4	214.8	7.9	8.3	6.7	306.6	45.6	0.5
41029.3	2038.2	195.7	206.3	214.0	213.8	7.6	7.5	5.4	380.9	57.6	0.4
40994.2	2038.2	196.4	205.6	212.1	214.2	6.4	8.6	7.7	264.4	41.9	0.5
40985.0	2038.2	196.2	205.7	211.5	213.9	5.7	8.2	6.5	313.0	49.4	0.5
40933.0	2038.2	195.7	205.6	217.2	213.3	11.7	7.8	6.1	335.6	45.6	0.4
40931.8	2038.2	195.7	205.5	212.0	213.0	6.5	7.4	6.2	330.1	45.1	0.4
40836.8	2588.2	194.4	204.6	210.3	211.8	5.7	7.2	7.7	337.3	65.2	0.6
40739.3	2588.2	193.6	204.1	210.4	209.5	6.3	5.4	6.5	398.5	61.5	0.5
40634.5	2588.2	192.4	203.5	210.1	207.7	6.6	4.2	6.6	390.9	62.8	0.5
40538.5	2588.2	191.8	203.0	208.8	207.2	5.8	4.3	6.8	382.0	54.8	0.5
40436.3	2588.2	191.2	202.1	207.1	205.8	5.0	3.7	7.7	334.5	53.1	0.5
40339.5	2588.2	190.8	201.0	205.3	204.1	4.3	3.1	8.4	308.0	50.2	0.6

H

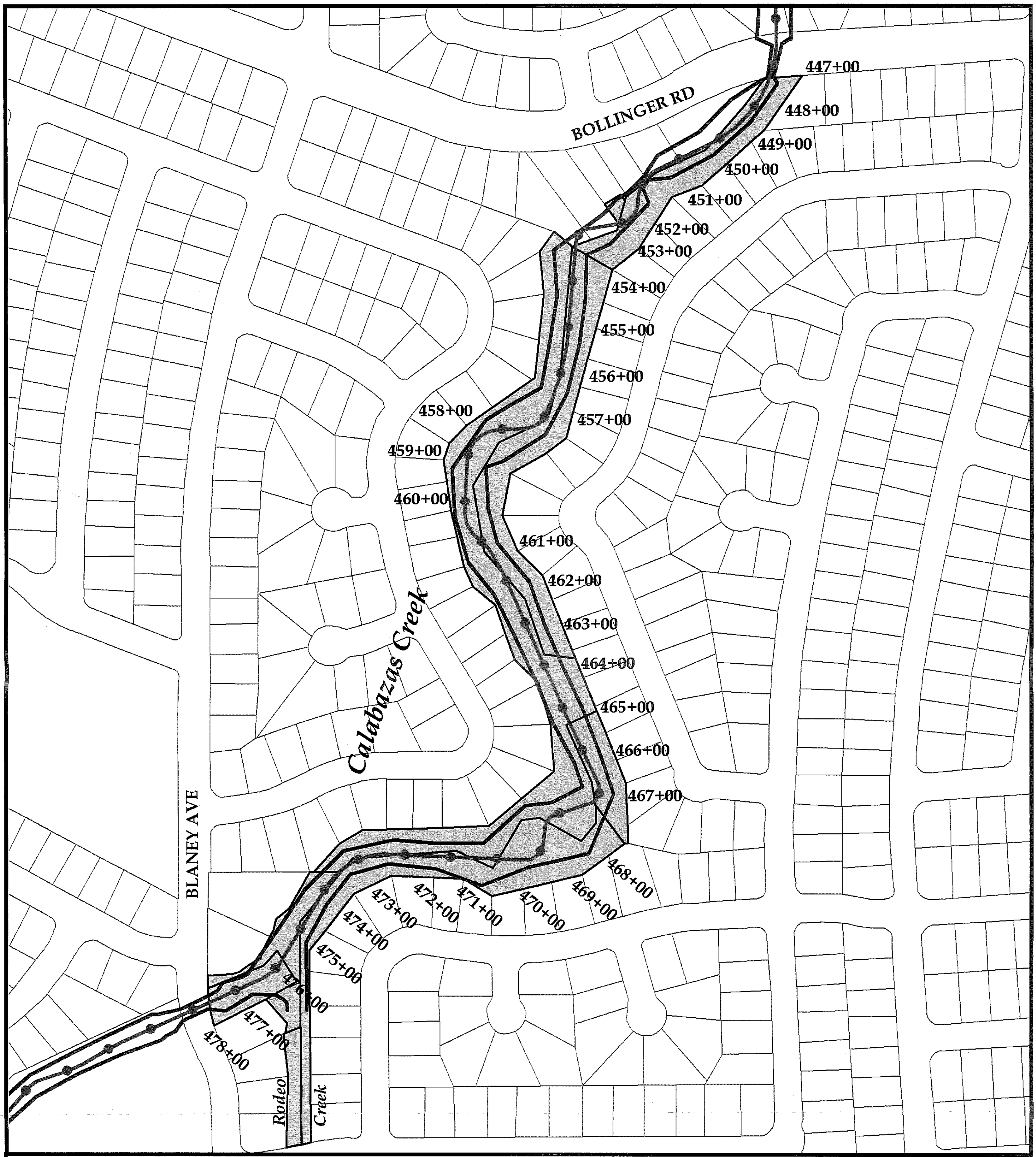
APPENDIX H

Rights of Way within Project Limits



Calabazas Creek
Reach 26
Miller Ave. to Bollinger Rd.

Figure



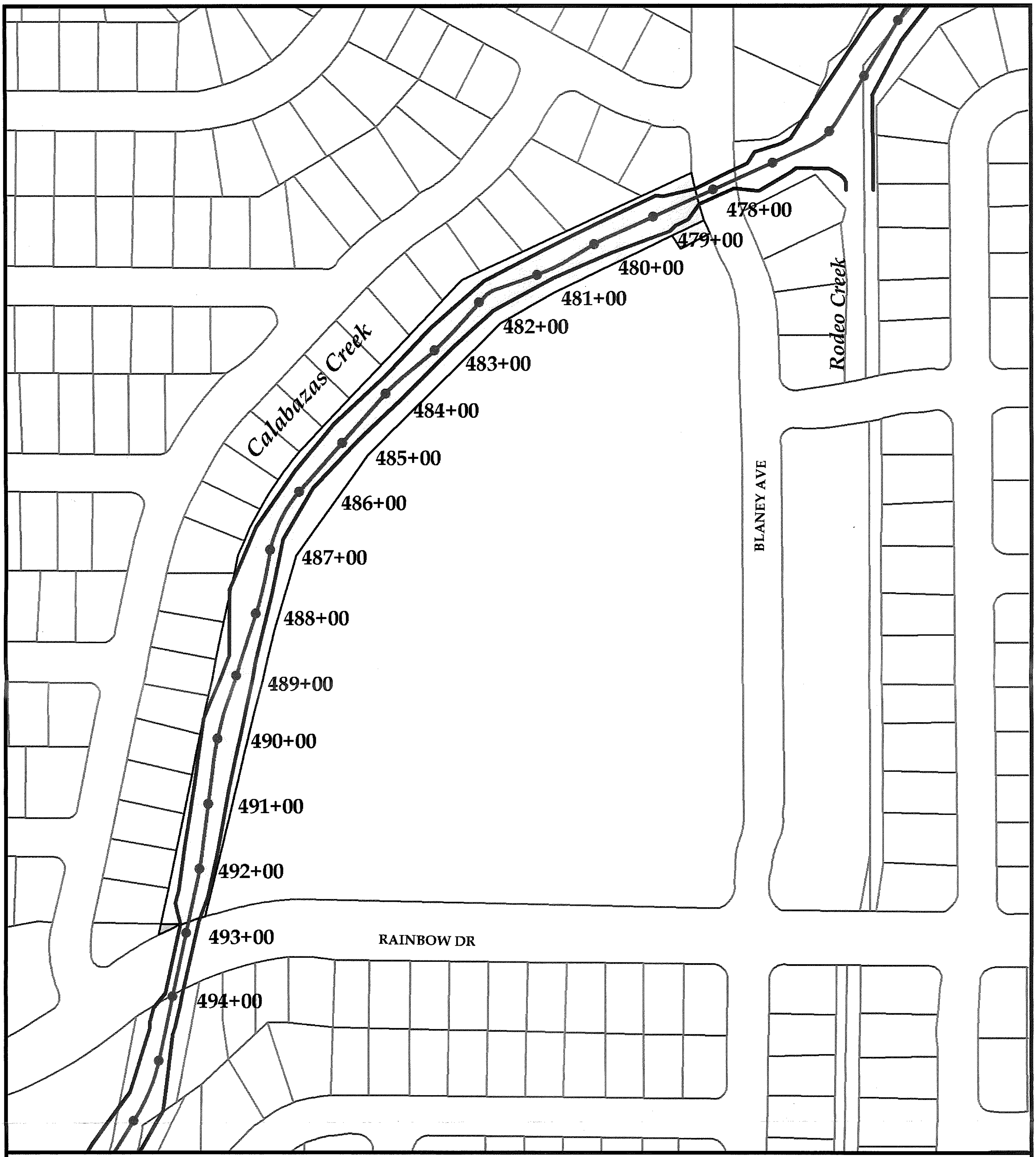
Calabazas Creek
Reach 27
Bollinger Rd. to Blaney Ave.

Figure

—	Top of Bank
—	Control Line
▨	SCVWD Fee

N
W E
S

100 0 100 200 Feet



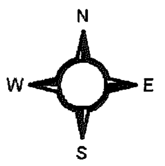
Calabazas Creek
Reach 28
Blaney Ave. to Rainbow Dr.

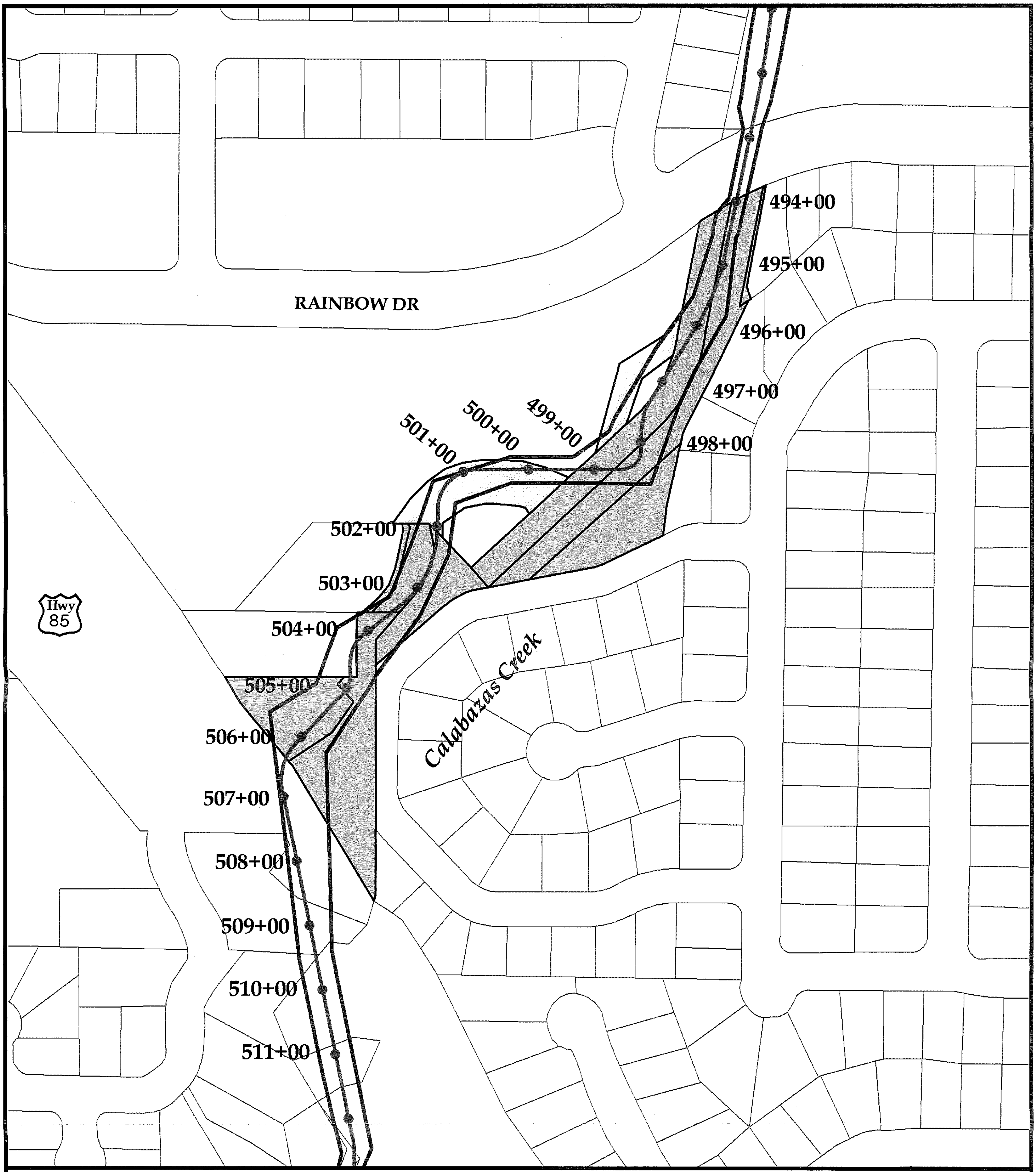
Figure

— Top of Bank

— Control Line

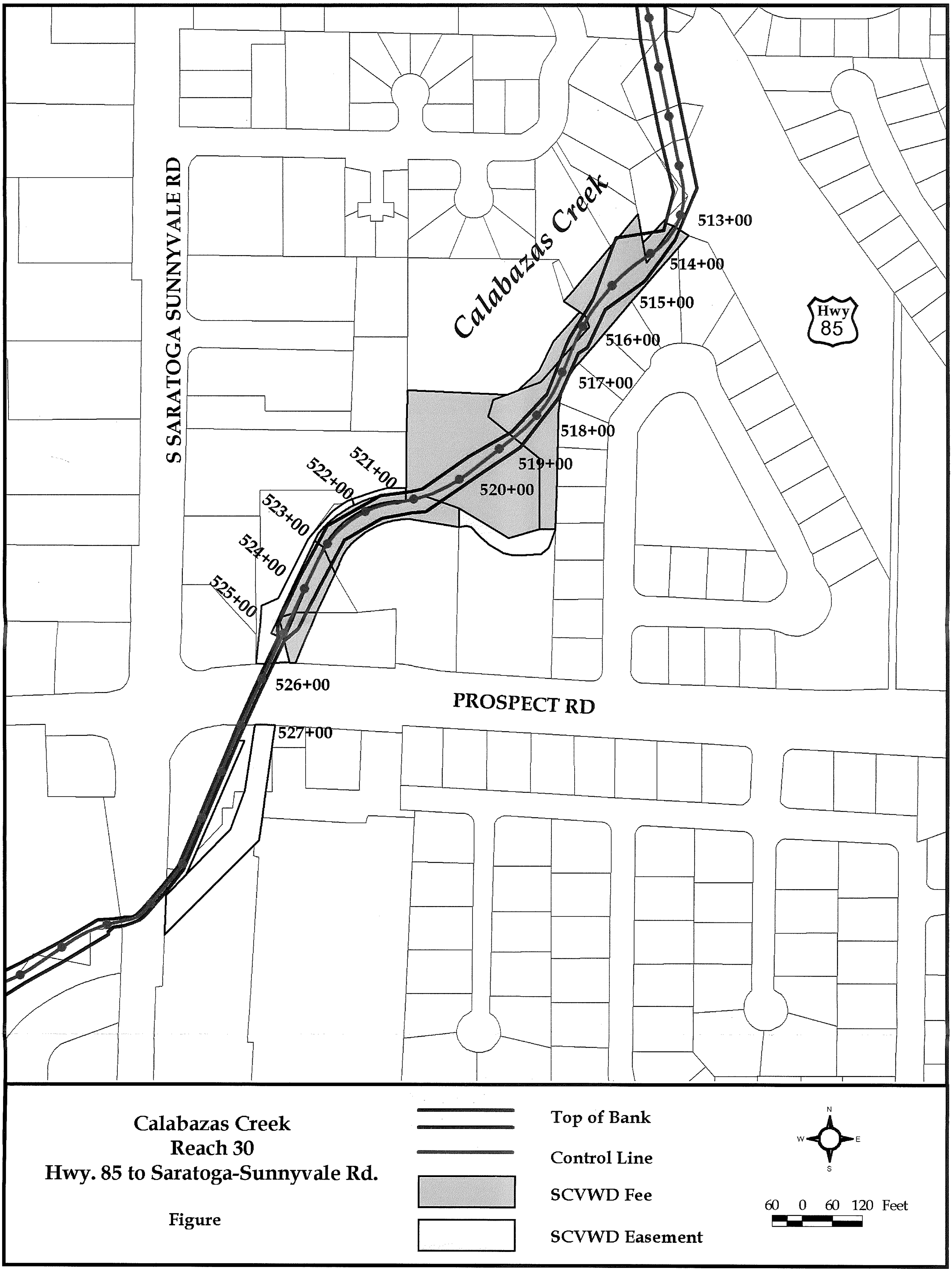
☐ SCVWD Easement





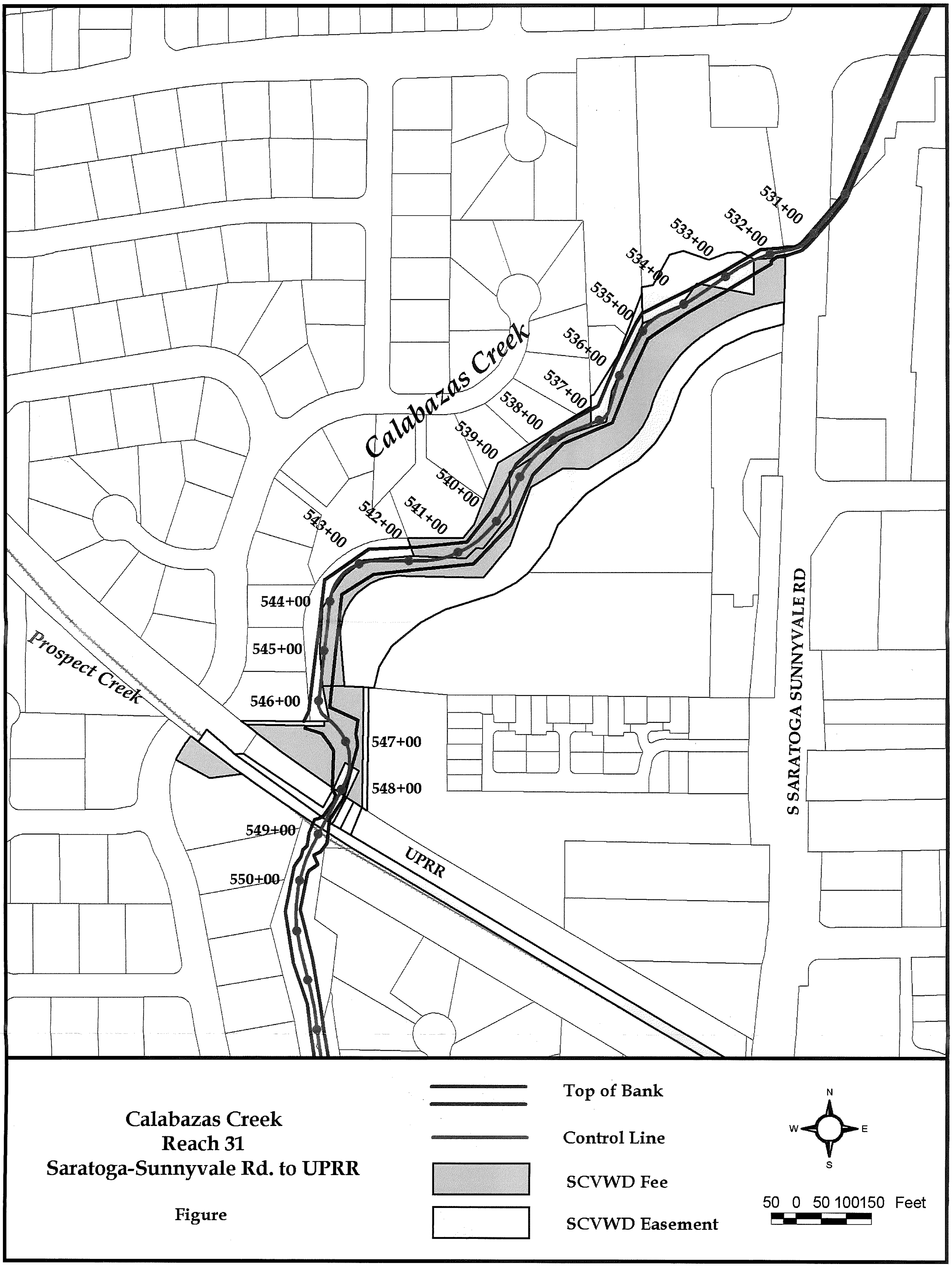
Calabazas Creek
Reach 29
Rainbow Dr. to Hwy. 85

Figure



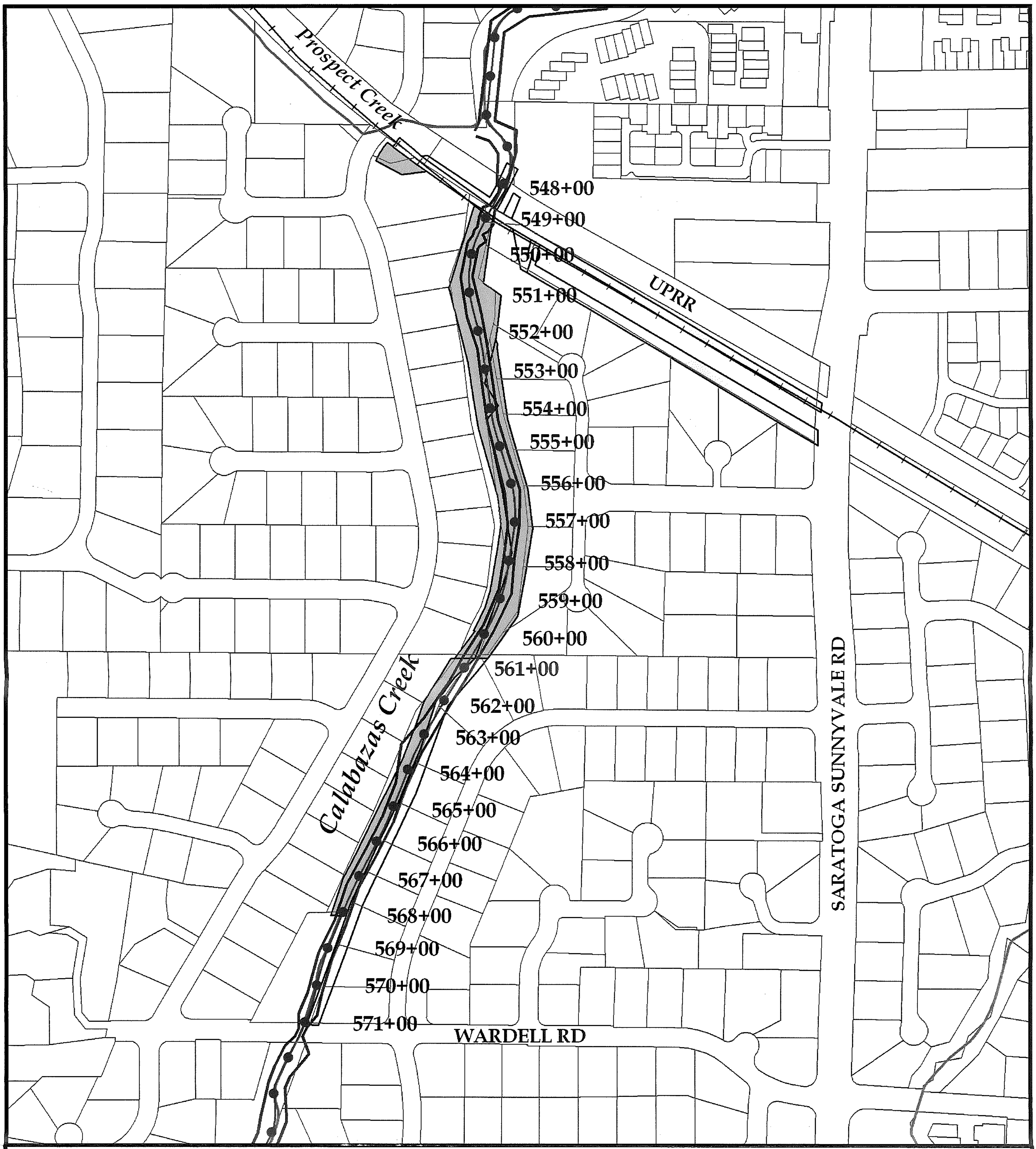
Calabazas Creek
Reach 30
Hwy. 85 to Saratoga-Sunnyvale Rd.

Figure



Calabazas Creek
Reach 31
Saratoga-Sunnyvale Rd. to UPRR

Figure



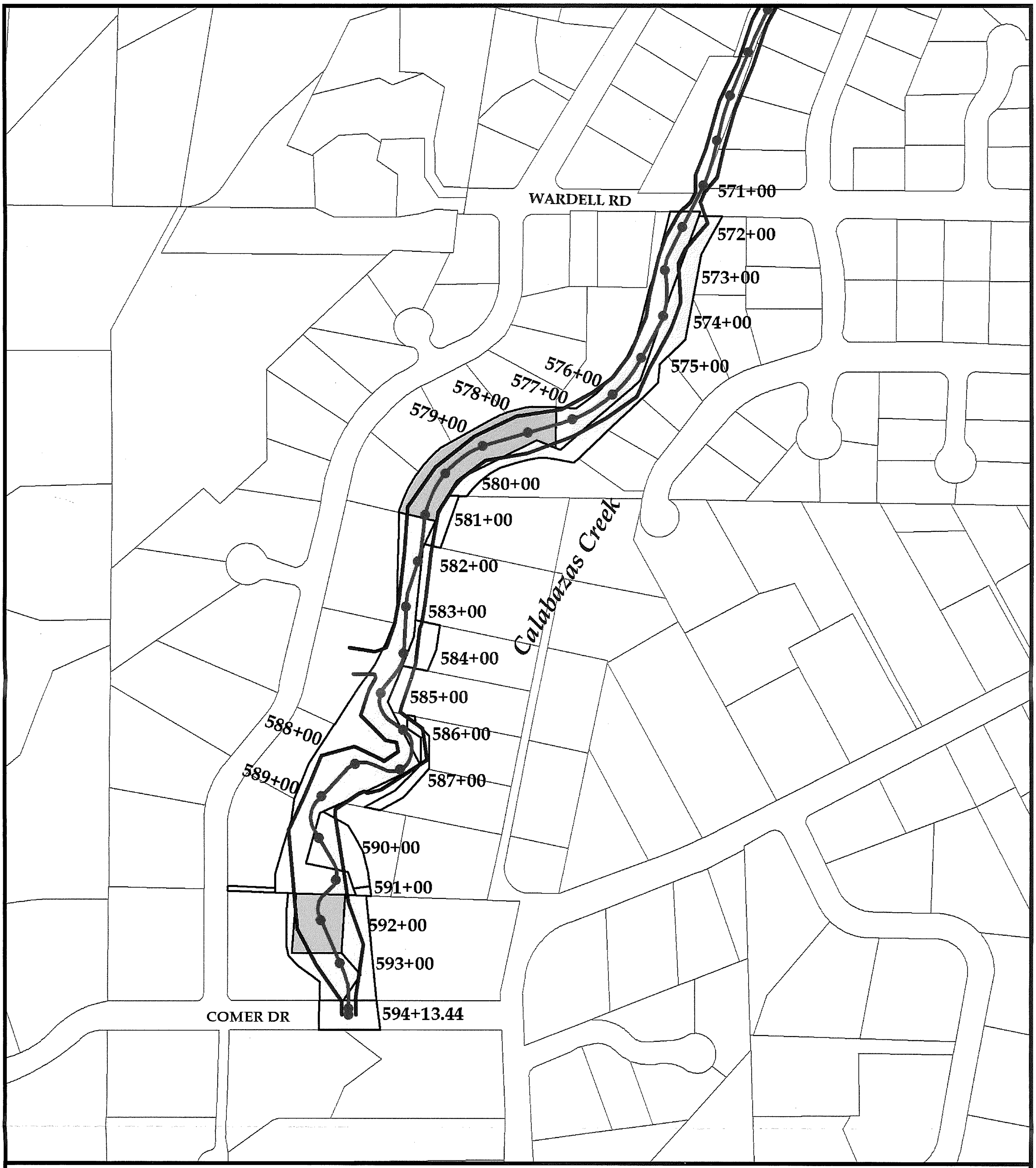
Calabazas Creek
Reach 32
SPRR to Wardell Rd.

═	**Top of Bank**
—	**Control Line**
▨	**SCVWD Fee**
☐	**SCVWD Easement**

N
W E
S

0 80 160 240
Feet

Miller to Comer 1-16-08\Contol line and TOB 4-14-08\Reach_32_easement&fee_SPRR-Wardell.mxd



Calabazas Creek
Reach 33
Wardell Rd. to Comer Dr.

Figure

APPENDIX I

Feasible Alternatives

Site 1: Calabazas Park

Alt 1A: Floodwall at Calabazas Park

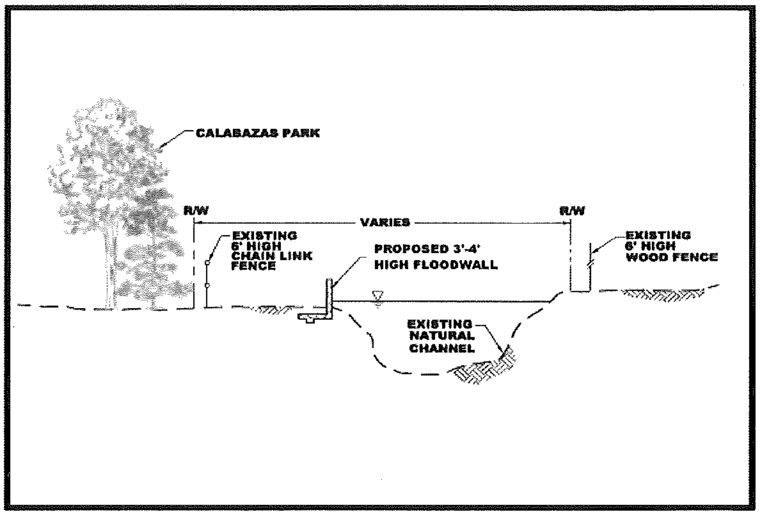
Approximately 200 foot channel section along Calabazas Park between Blaney Avenue and Rainbow Drive (approx. STA 486+77 to STA 488+72) would be modified by placement of a floodwall 0-3 feet in height along the top of the existing east bank.

This length of creek is currently a natural trapezoidal earthen channel. The east side (Calabazas Park) of the creek will flood during a 1% flood event. To prevent the channel from flooding at this location, a floodwall could be installed on top of the existing east bank. The increase in channel height will enlarge the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

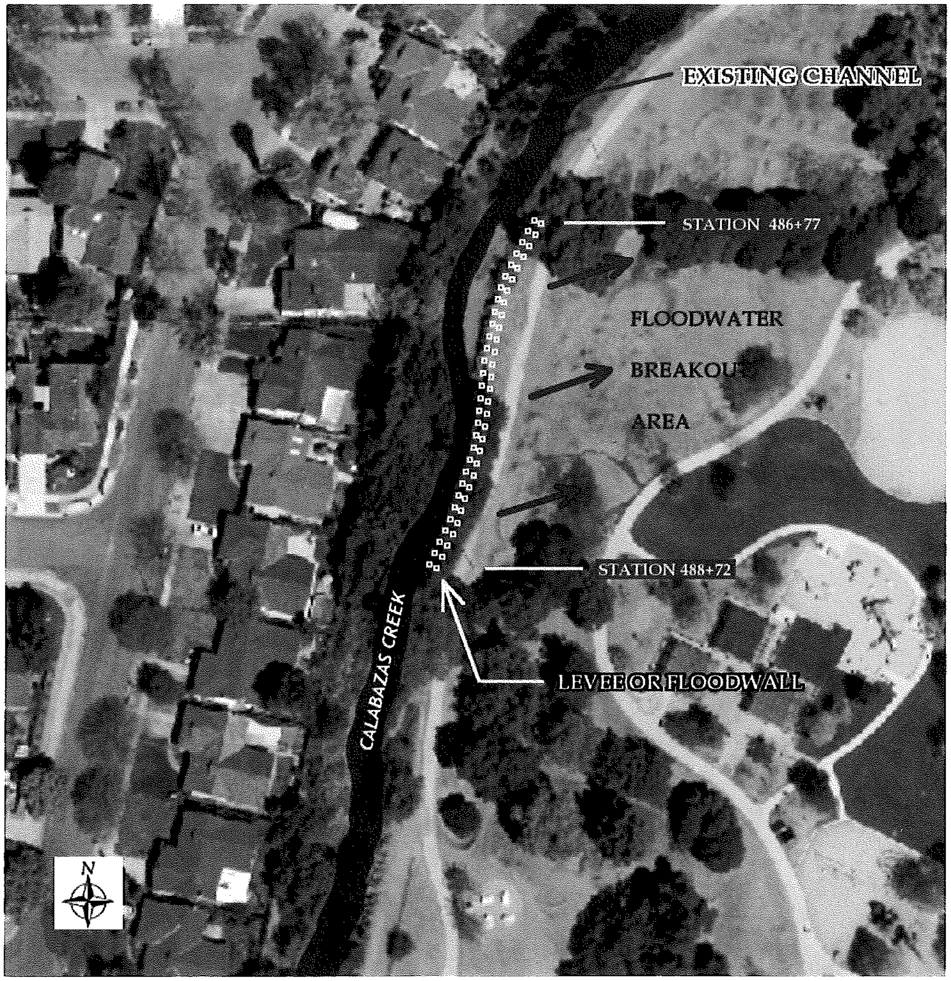
Construction of "Alt 1A" will benefit Calabazas Park and the adjacent areas including the YMCA and library. Concerns associated with Alt 1A include the temporary loss or relocation of trees, as well as noise and dust impact during construction. The floodwall construction could be completed in one construction season.

Existing Operation and Maintenance (O&M) activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Looking Upstream


CALABAZAS PARK
R/W
VARIES
R/W
EXISTING 6' HIGH CHAIN LINK FENCE
PROPOSED 3'-4' HIGH FLOODWALL
EXISTING 6' HIGH WOOD FENCE
EXISTING NATURAL CHANNEL

Floodwall on east bank



Plan View

Alt 1B: Channel Widening at Calabazas Park

Approximately 200 foot channel section along Calabazas Park between Blaney Avenue and Rainbow Drive (approx STA 486+77 to STA 488+72) would be enlarged.

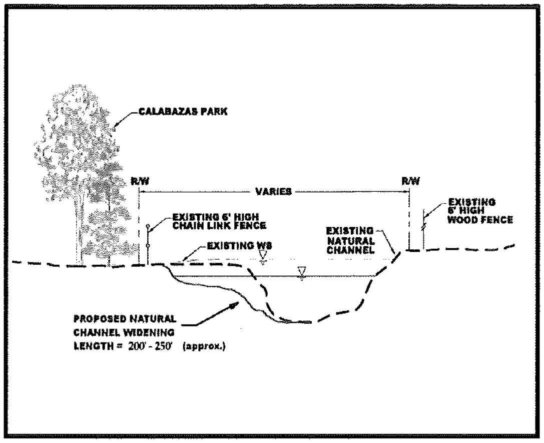
Creek geometry at this location is currently a natural trapezoidal earthen channel. Flood waters will overtop the east bank and enter Calabazas Park and the adjoining neighborhood during high flow. During construction, the existing trapezoidal channel at the affected location would be excavated and rebuilt wider. Enlarging the existing channel would increase creek capacity sufficiently enough to contain the 1% design flow with the required freeboard.

Construction of "Alt 1B" will benefit Calabazas Park and the adjacent areas including the YMCA and library. Construction of this element will produce additional habitat for fish and wildlife as a result of channel widening. Concerns associated with Alt 1B include a slight reduction in space along Calabazas Park, the temporary loss of trees, as well as noise and dust impact during construction.

All construction would occur within existing rights-of-way. No new rights-of-way or land acquisition would be needed. The Channel widening at Calabazas Park could be completed in one construction season (one summer).

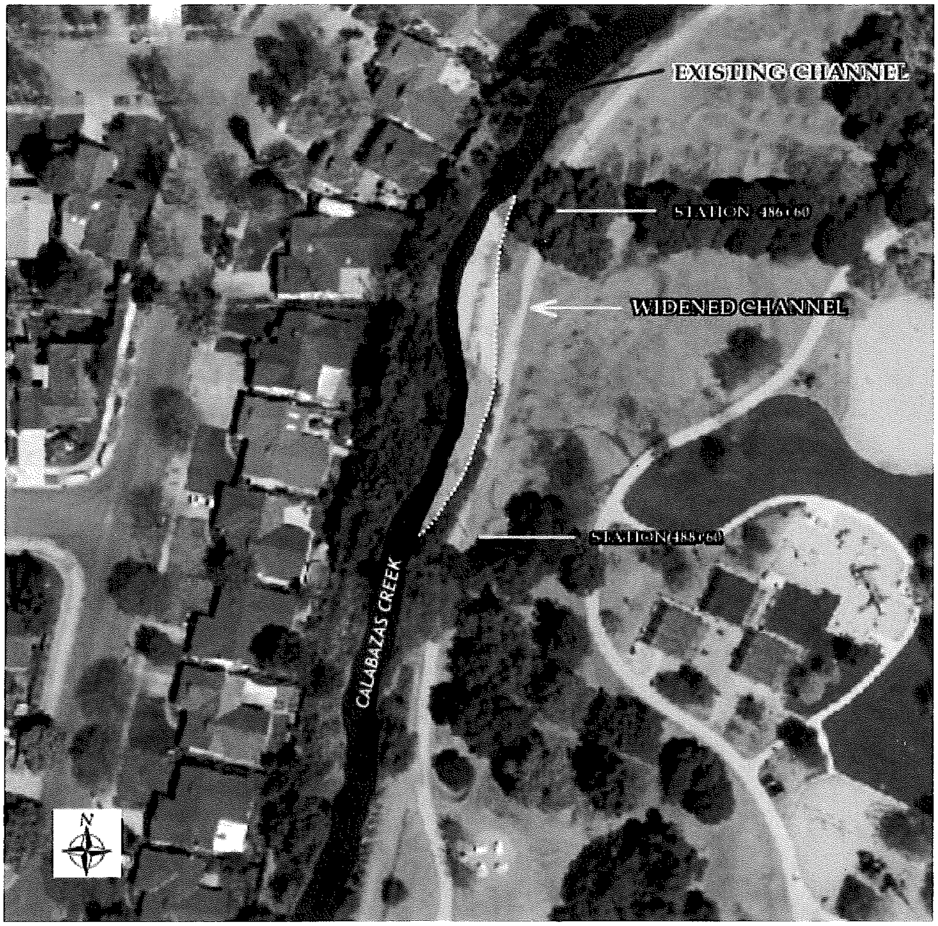
Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Looking Downstream From East Bank


CALABAZAS PARK
R/W
VARIES
R/W
EXISTING 6' HIGH WOOD FENCE
EXISTING 6' HIGH CHAIN LINK FENCE
EXISTING WS
EXISTING NATURAL CHANNEL
PROPOSED NATURAL CHANNEL WIDENING LENGTH = 200' - 250' (approx.)

Looking Upstream

Looking Downstream



Plan View

Alt 1C: BMX Park Grade elevation at Calabazas Park

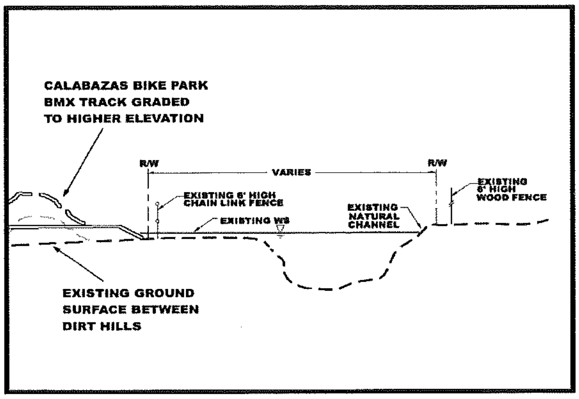
Approximately 200 foot channel section through Calabazas Park (approx. STA 486+77 to STA 488+72) might not need to be modified. The City of San Jose has scheduled the construction of a BMX Park adjacent to the Creek in this vicinity. BMX work began Dec 2006 and will be completed early 2007. Flood waters could conceivably be contained by grading the BMX Park low points to an elevation higher than the 1% flood water elevations at the top of the existing left bank (looking u/s).

Construction of "Alt 1C" will benefit Calabazas Park and the adjacent areas including the YMCA and library. Since the City of San Jose has already approved plans to construct the BMX track, coordination with the SCVWD to raise the grade elevation will not increase the noise and dust impact during construction.

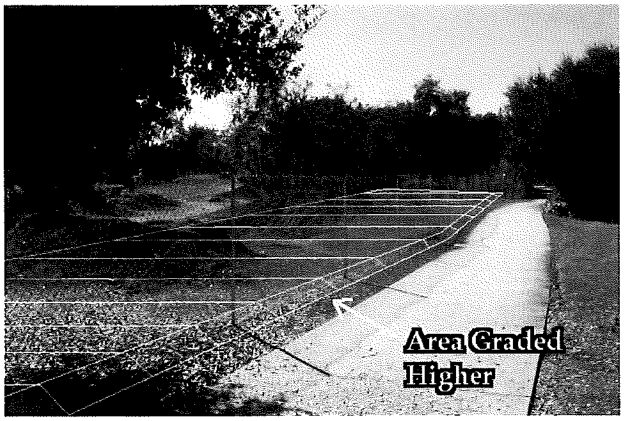
All construction would occur on City of San Jose property. No new rights-of-way or land acquisition would be needed.

Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

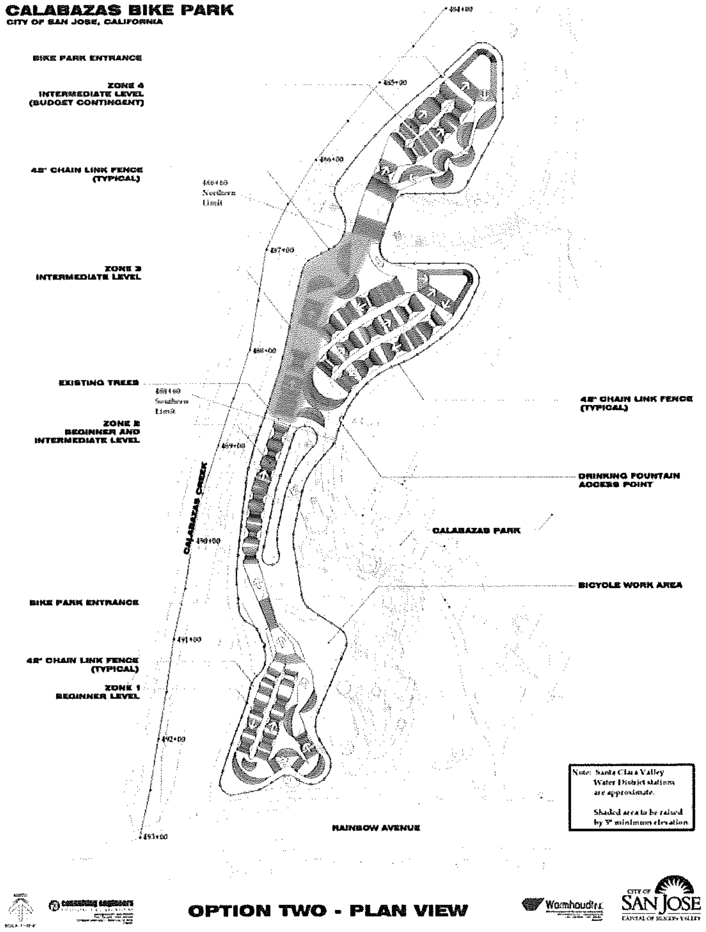
Looking Upstream



Looking Upstream



Looking Upstream



Plan View

Site 2: Foot Bridge

Alt 2A: Raise existing Foot Bridge & Floodwall

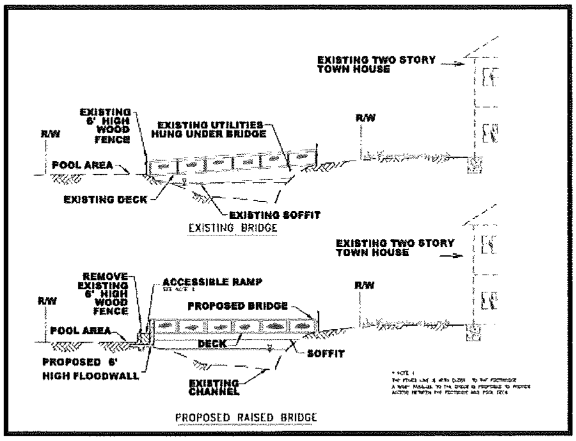
This element entails work near an existing foot bridge currently located between Rainbow Drive and Highway 85, from approximate STA 501+36 to STA 501+43. This existing foot bridge is currently located approximately 600 feet downstream of Highway 85. The foot bridge connects the Cupertino Creekside Condominiums on the north bank of the creek to the pool on the south bank of the creek.

Creek geometry at this location is currently a natural trapezoidal earthen channel. Currently, the low bridge height on the east end is an obstacle and impedance during high water flow. The east side of the creek will flood during 1% flow. Flooding on the east side would cause flooding of the Cupertino Creekside Condominium swimming pool and adjacent private homes on Calabazas Creek Circle. To prevent flooding upstream and downstream of the existing footbridge during high flow events, the east side of the foot bridge would be raised to the same elevation as the west bank and floodwalls approximately 6-feet in height would be installed for approximately 350-feet along the top of the existing east bank. The increase in channel height will enlarge the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard. Easy access to the Condominium pool would be maintained, while providing increased creek capacity.

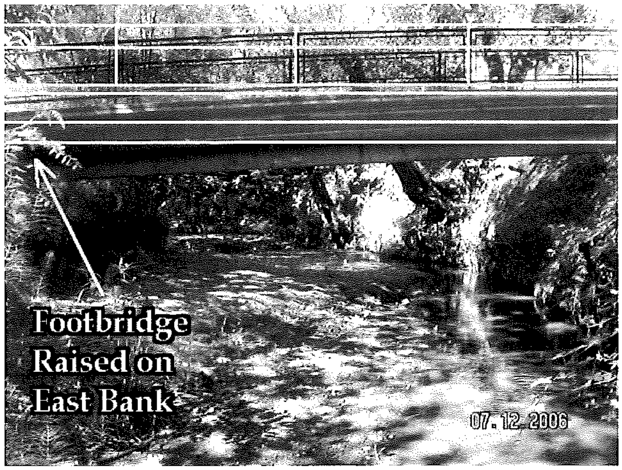
Construction of this element will benefit the adjacent property along Calabazas Creek Circle and the area between Hwy 85 and Rainbow Drive. Temporary impacts of this element include the loss of trees, limited accessibility to the Condominiums swimming pool, and the noise and dust associated with construction activities.

Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

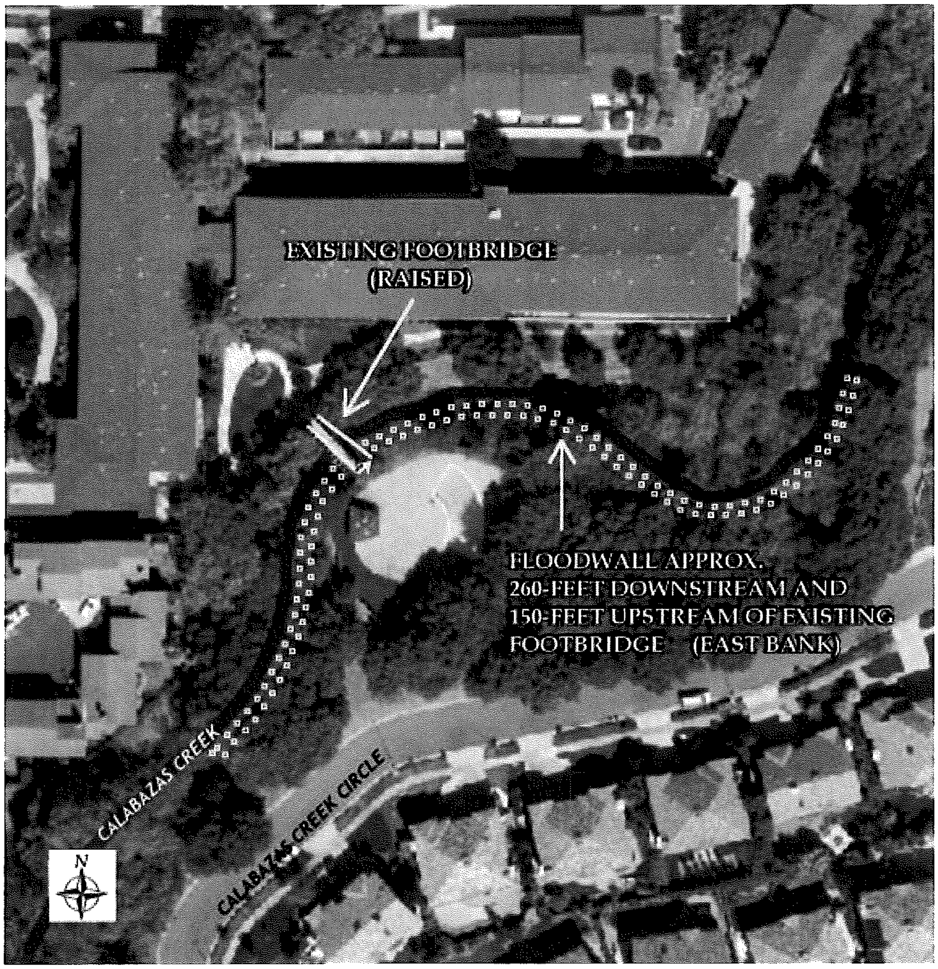
Looking Upstream


EXISTING TWO STORY TOWN HOUSE
EXISTING 6' HIGH WOOD FENCE
R/W
EXISTING UTILITIES HUNG UNDER BRIDGE
R/W
POOL AREA
EXISTING DECK
EXISTING SOFFIT
EXISTING BRIDGE
EXISTING TWO STORY TOWN HOUSE
REMOVE EXISTING 6' HIGH WOOD FENCE
ACCESSIBLE RAMP
R/W
R/W
PROPOSED BRIDGE
POOL AREA
DECK
SOFFIT
PROPOSED 6' HIGH FLOODWALL
EXISTING CHANNEL
PROPOSED RAISED BRIDGE

Looking Upstream



Looking Upstream



Plan View

Alt 2B: Relocate existing Foot Bridge & Floodwall

This element entails work on and work near the existing footbridge. The current location of this existing footbridge is described above in the first paragraph of (Alt 2A).

The foot bridge would be removed and relocated approximately 100-feet upstream of the existing location. Relocation of the bridge would maintain access to the Condominiums swimming pool located on the east side of the creek.

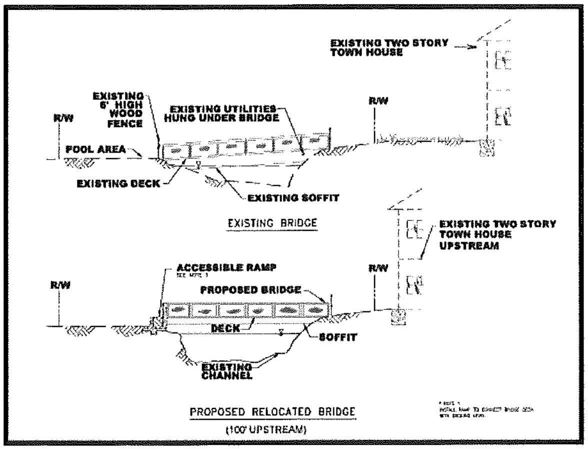
Alt 2B includes the installation of a floodwall approximately 6-feet in height and 400-feet in length along the top of the east bank.

To prevent flooding upstream and downstream of the foot bridge during high flow events, the bridge would be rebuilt at a higher elevation 100-feet upstream of the existing location. Relocation of the foot bridge, and the accompanying raise in height, will increase the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Construction of "Alt 2B" will benefit the adjacent property along Calabazas Creek Circle and the area between Highway 85 and Rainbow Drive. In addition to relocation of the foot bridge, "Alt 2B" also includes construction of a floodwall from a point approximately 350 feet downstream of the relocated foot bridge and ending at the relocated foot bridge. During the construction phase, use of the Condominiums swimming pool will be less convenient. There may also be a temporary loss of habitat due to clearing, and the associated noise and dust impacts.

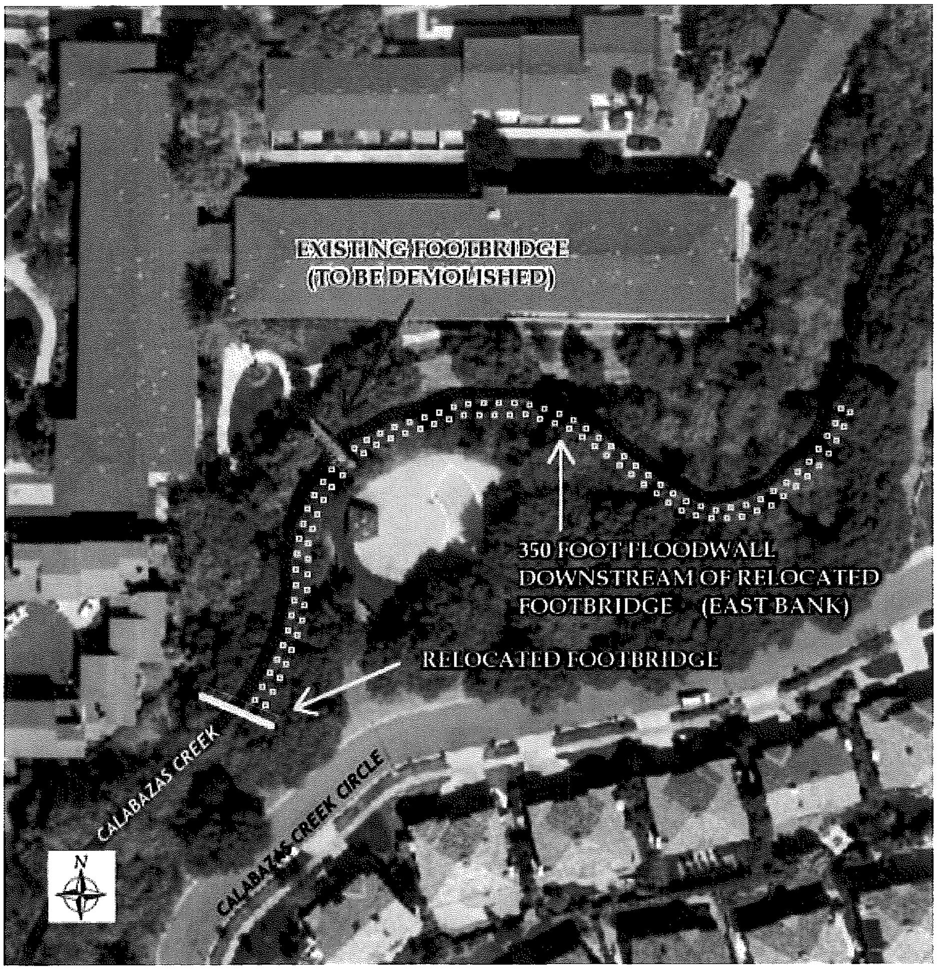
Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Looking Downstream


EXISTING TWO STORY TOWN HOUSE
EXISTING 6' HIGH WOOD FENCE
EXISTING UTILITIES HUNG UNDER BRIDGE
R/W
R/W
POOL AREA
EXISTING DECK
EXISTING SOFFIT
EXISTING BRIDGE
EXISTING TWO STORY TOWN HOUSE UPSTREAM
ACCESSIBLE RAMP
R/W
R/W
PROPOSED BRIDGE
DECK
SOFFIT
EXISTING CHANNEL
PROPOSED RELOCATED BRIDGE
(100' UPSTREAM)

Looking Upstream

Looking Upstream



Plan View

Site 3: Prospect to Saratoga-Sunnyvale Tunnel

Alt 3A: Underground RCB Bypass

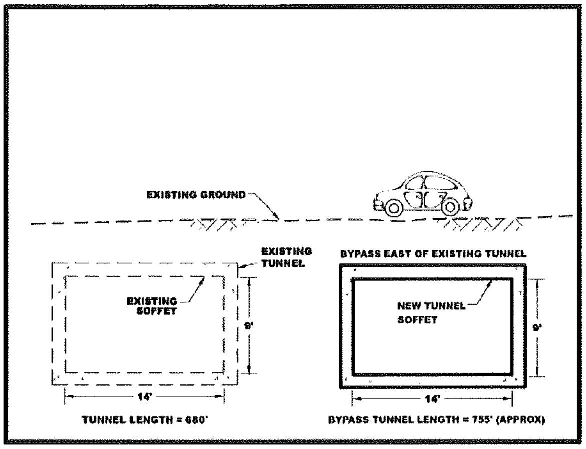
A 9-foot by 14-foot underground reinforced concrete box (RCB) bypass (approx. STA 525+11 to STA 531+94) would be constructed with a different alignment along the existing tunnel from Prospect Road to Saratoga-Sunnyvale Road under the San Jose National Bank (SJNB) parking lot on the east side.

To prevent flooding upstream of the tunnel (Saratoga-Sunnyvale Road) during high flow events, the RCB bypass would be constructed along the existing tunnel. Bypasses are appropriate where environmental features or access problems prevent enlargement or improvement of the existing undersized tunnel, undersized creek, or other undersized structure. The proposed RCB bypass will route excess flows around the problem area into the channel further downstream. The underground RCB bypass would be constructed with a different alignment along the existing curved Prospect to Saratoga-Sunnyvale Road tunnel under the SJNB parking lot. The new RCB bypass would be approximately 755 feet long, with a capacity of half of the 1% design flow.

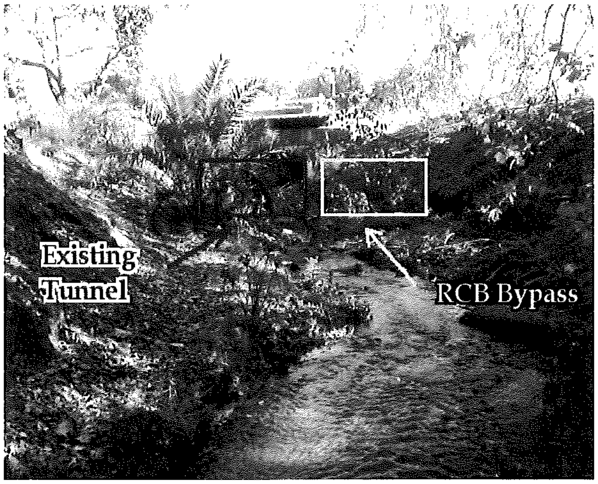
It is expected that the new RCB bypass would be constructed partly within existing utility and SCVWD easements. However, adequate SCVWD easements are not in place to allow the work in "Alt 3A". This District will need to coordinate with the SJNB, the City of Saratoga and the City of San Jose to secure the necessary easements for this work.

Once trenching and RCB installation is complete, trenches would be backfilled and pre-construction road surface conditions would be restored. Some of the excavated materials would be exported from the site. Construction of the new RCB bypass would be completed in sections to minimize road closures and traffic disruption. Construction and installation is expected to last two years.

Looking Downstream



Looking Downstream



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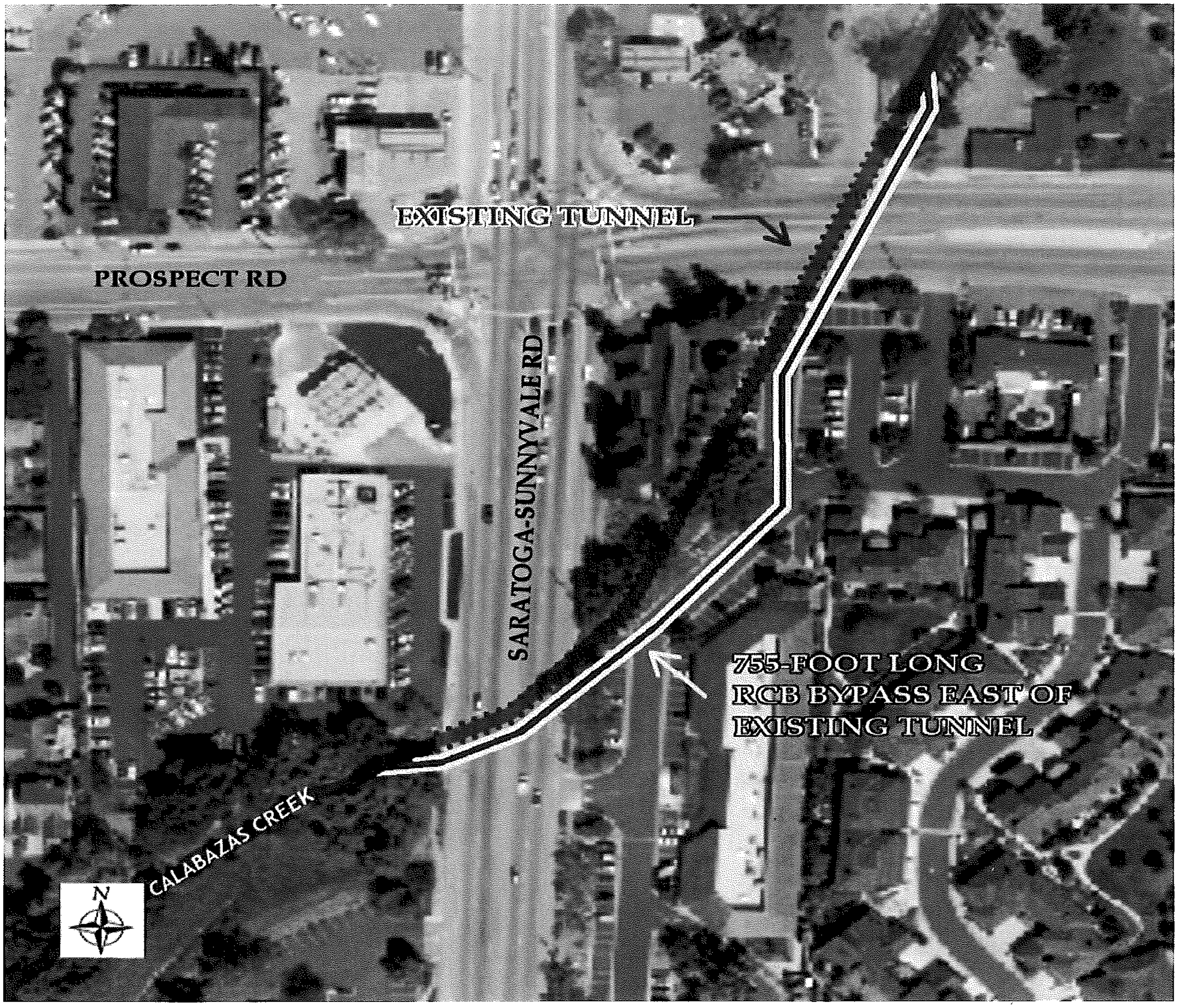


Plan View

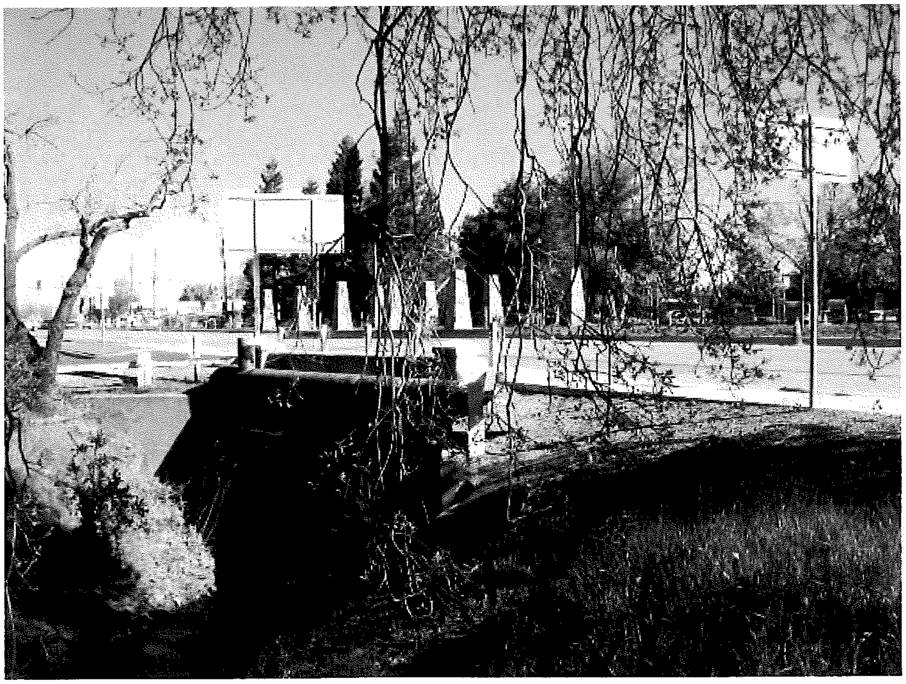
Alt 3B: Additional RCB / New Double RCB

An additional 9-foot by 14-foot underground reinforced concrete box (RCB) would be constructed along the left side (looking upstream) of the existing 9-foot by 14-foot (average size of u/s & d/s face) underground concrete tunnel with a length of approximately 685 feet from Prospect Road to Saratoga-Sunnyvale Road (approx. STA 525+11 to STA 531+94), or the existing tunnel would be replaced by a new 9-foot by 14-foot reinforced concrete double box (RCB).

Additional RCBs are appropriate where the 1% flood design flow significantly exceeds the capacity of the existing tunnel. To prevent flooding upstream of the Saratoga-Sunnyvale Road tunnel during high flow events, an additional RCB would be constructed along the west side of the existing 685-foot long tunnel and be approximately the same length and cross sectional size. If it proves to be more feasible, another option is to completely replace the old tunnel by a new double RCB sized to convey the 1% flow. Either option proposed for "Alt 3B" will follow a route similar to the existing tunnel which traverses the San Jose National Bank property in a curved alignment.

Construction of "Alt 3B" will benefit the business and residential areas upstream and southwest of Saratoga-Sunnyvale Road. It will also prevent inundation of two of the major roadways in and out of Saratoga with flood waters. Construction work will temporary impact traffic and possibly cause a temporary loss of parking places for local businesses. Existing trees will be impacted and the area will definitely experience temporary noise and dust impacts during construction.

Operation and maintenance of the Saratoga-Sunnyvale additional RCB or new double RCB would be minimal. Although each would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.



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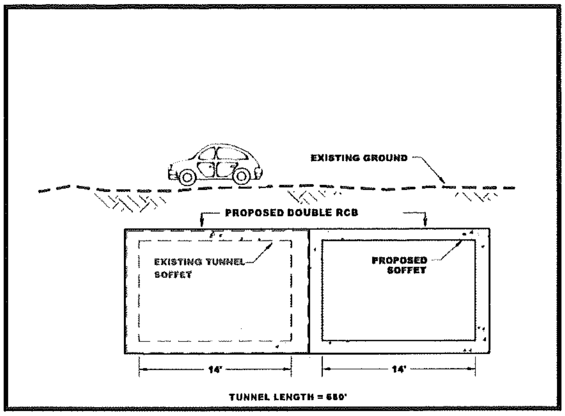

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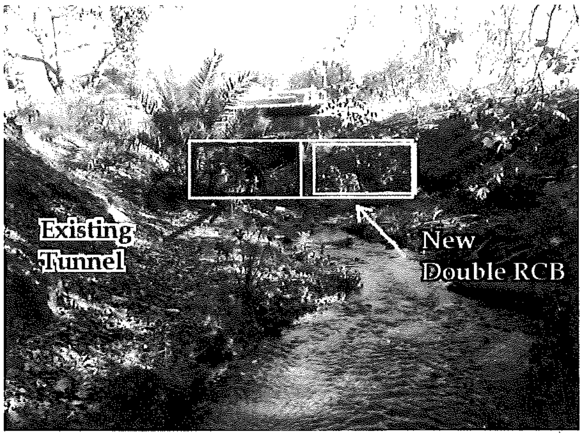
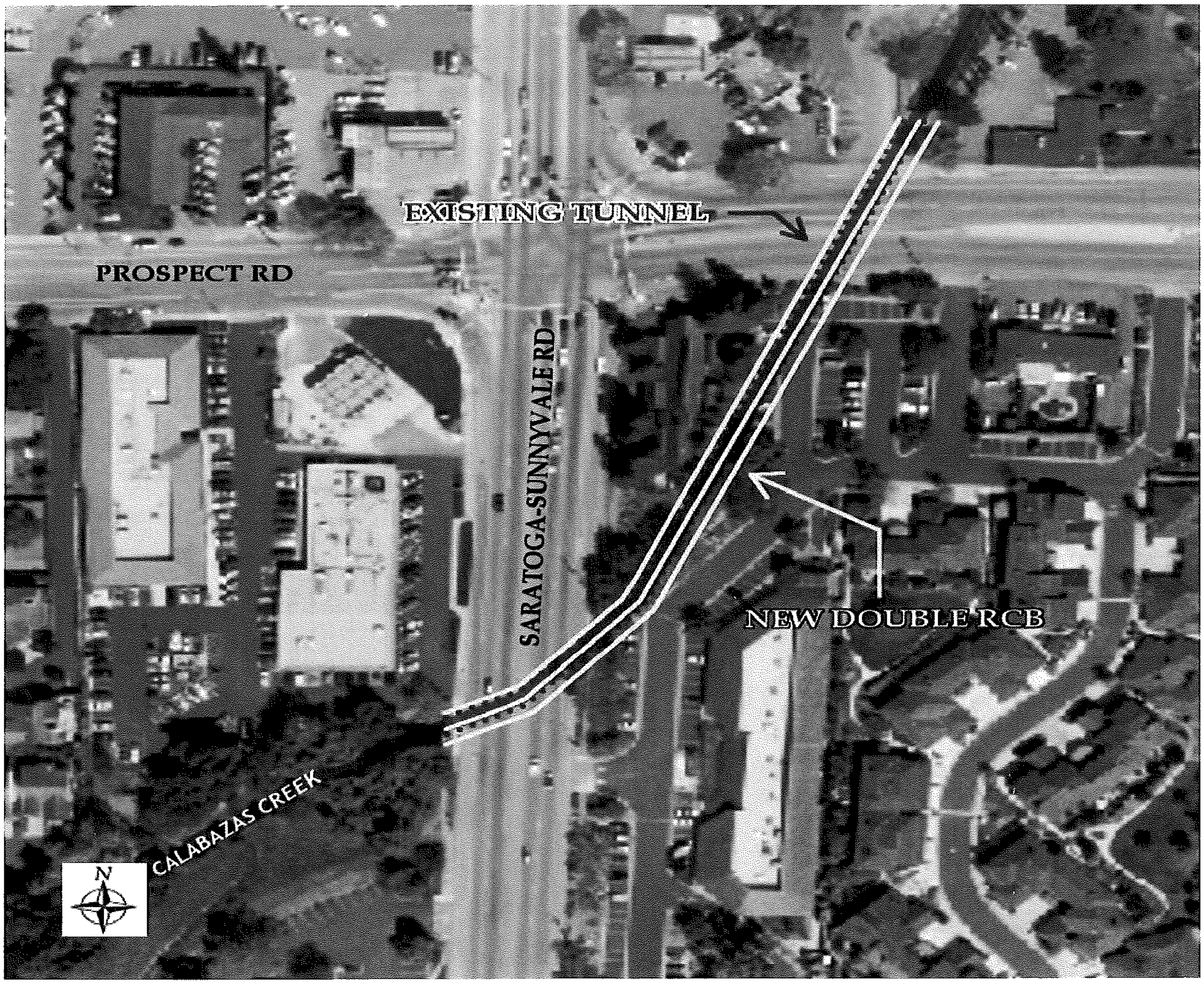


Looking Downstream



Plan View

Alt 3C: Floodwall

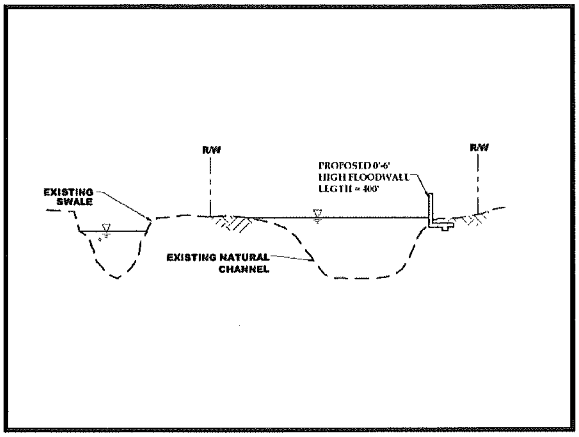
This element involves the construction of a floodwall approximately 6-feet in height on the west bank upstream of the Saratoga-Sunnyvale Road underground tunnel (approx. STA 531+94 to STA 535+89).

Creek geometry at this location is currently a natural trapezoidal earthen channel. The west side of the creek will flood during a 1% flow event. Mitigation can be accomplished by the 6-feet addition of a flood wall on the existing west (northern) bank. The increase in the height of the channel will improve the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

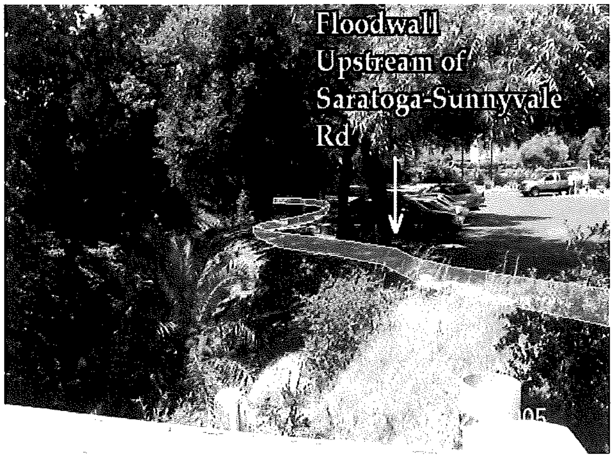
Construction of "Alt 3C" will protect the Coldwell Banker Blue Hills parking lot from flooding. Construction will also have temporary traffic impacts and possible temporary loss of parking for local businesses, potential impact to existing trees, as well as temporary noise and dust impacts during construction.

Existing operation and maintenance activities are expected to continue within the project limits. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal will remain the same and some additional maintenance activities would be required for graffiti removal.

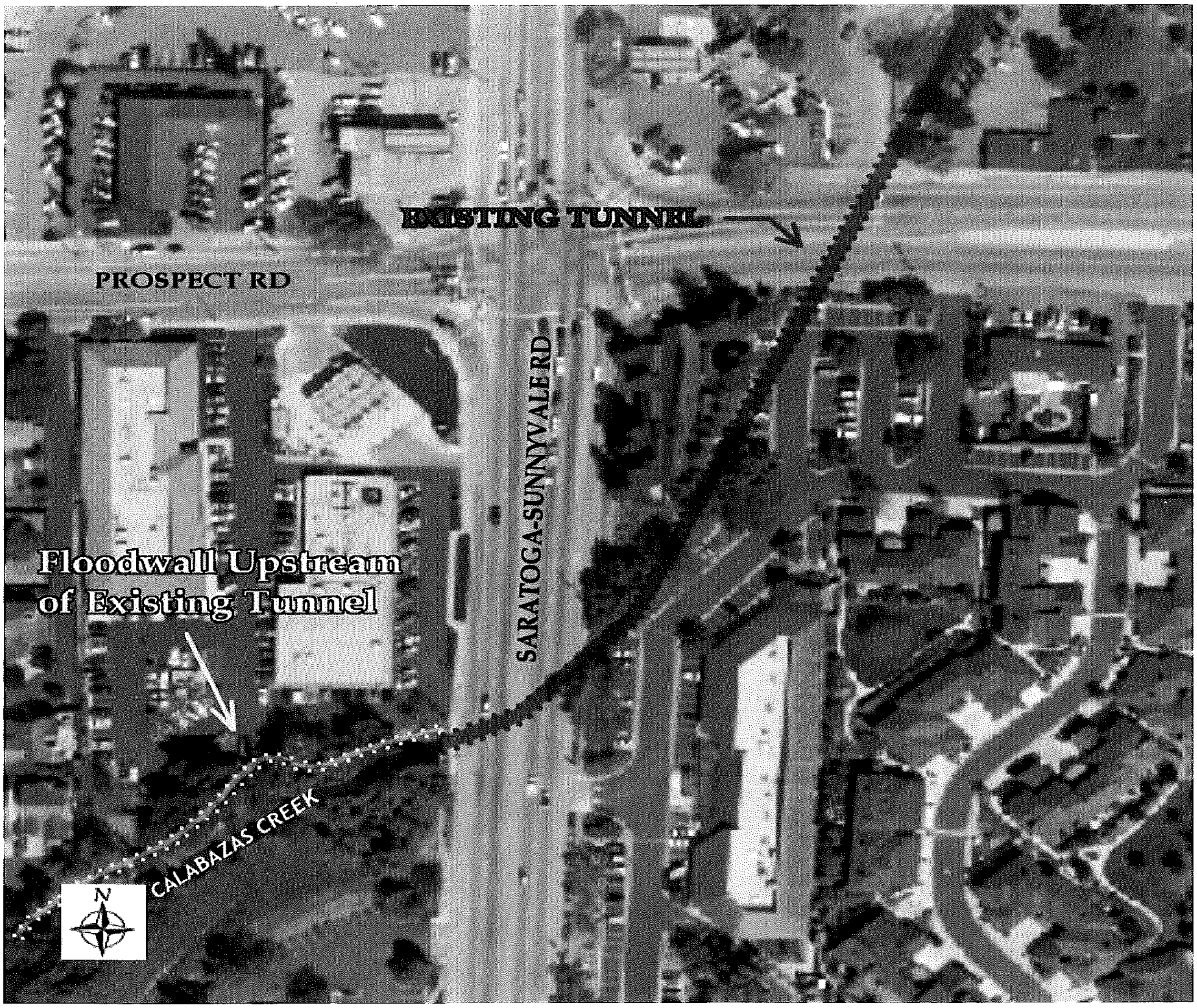
Looking Upstream



Looking Upstream



Looking Upstream



Plan View

Alt 3D: Swale Detention Basin

A large swale approximately 1350 feet long and 65 feet wide runs parallel to Calabazas Creek from Saratoga-Sunnyvale Road to downstream of the UPRR (STA 533+00.9 to STA 546+17.7) on the east side of the creek.

This swale is a trapezoidal earth with both straight and meandering alignment along Calabazas Creek. Upstream of the Prospect to Saratoga-Sunnyvale tunnel, Calabazas Creek is a relatively narrow channel with shallow top of banks and some erosion on the east bank. Further upstream, the creek's east bank is covered with sacked concrete and the west bank is covered with some rocks and broken concrete slabs. In some areas, there are erosion problems on the left bank slope due to bare soil material. Invert material is mostly coarse gravel and fine gravel. In this area flood flows overtop channel banks and inundate adjacent properties on the west side of the creek (Blue Hills parking lot) resulting in flood-related damages to residences and businesses.

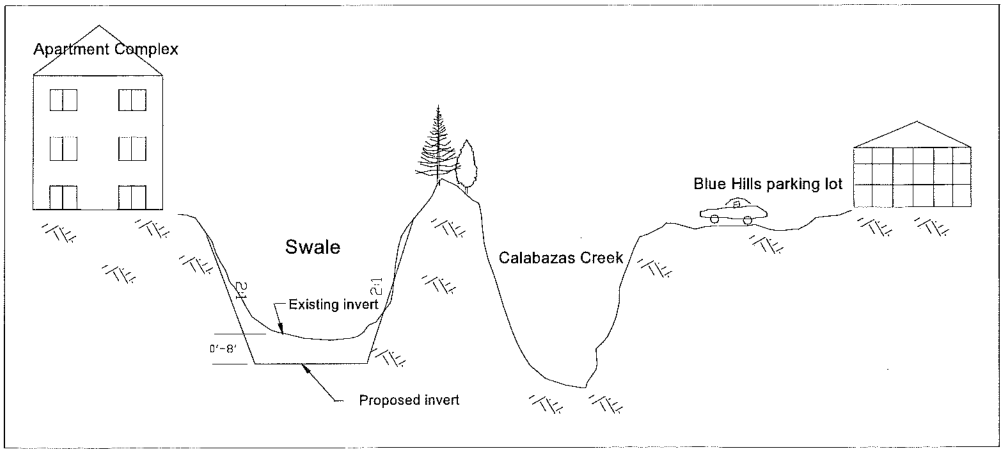
This element involves the construction of flow detention elements to reduce downstream flow rates by temporarily storing the peak portion of the flood, releasing the stored volume after the peak has passed. An off-stream detention facility, in the swale area on the east side of Calabazas Creek between Saratoga-Sunnyvale Road and UPRR, would be constructed to prevent flood inundation of the Prospect and Saratoga-Sunnyvale Road intersection, businesses and residential areas upstream and southwest of Saratoga-Sunnyvale Road. The new facility would capture and detain runoff from the upper Calabazas Creek watershed during storm events that produce high flow rates. The peak flows are stored in these areas until creek flows drop back to a safe level and the stored flows can be released back into the creek. This will reduce downstream flow rates and the potential for flooding further downstream.

The approximate depth of the detention facility would be 0-8 feet deeper than existing depth, producing approximately 9 acre-feet of storage volume. This detention basin would include structures like three weirs and a gate and a floodwall at downstream end of the swale for a short distance. The First weir would be built at the upstream end of the swale approximately 210 feet long on the left bank (looking upstream) of Calabazas Creek to divert flood water into the swale. The Second weir would be built about 400 feet downstream of the first weir approximately 35 feet in length. These two weirs would be designed at an elevation so that the swale storage area doesn't collect any creek water until a very large peak flow or storm surge comes down Calabazas Creek. When an upstream peak flow travels down Calabazas Creek toward the weirs, the peak flow water elevation would be high enough to overtop the weirs and fill the storage area. The peak flow would then be temporarily stored in the detention facility. The third weir would be built at the downstream of the swale approximately 45 feet long on the left bank (looking upstream) of Calabazas Creek with a drainage pipe about 1 foot in diameter and a flap gate at its outlet. When water level drops to a safe level, the flap gate would be opened to release the water back to the creek.

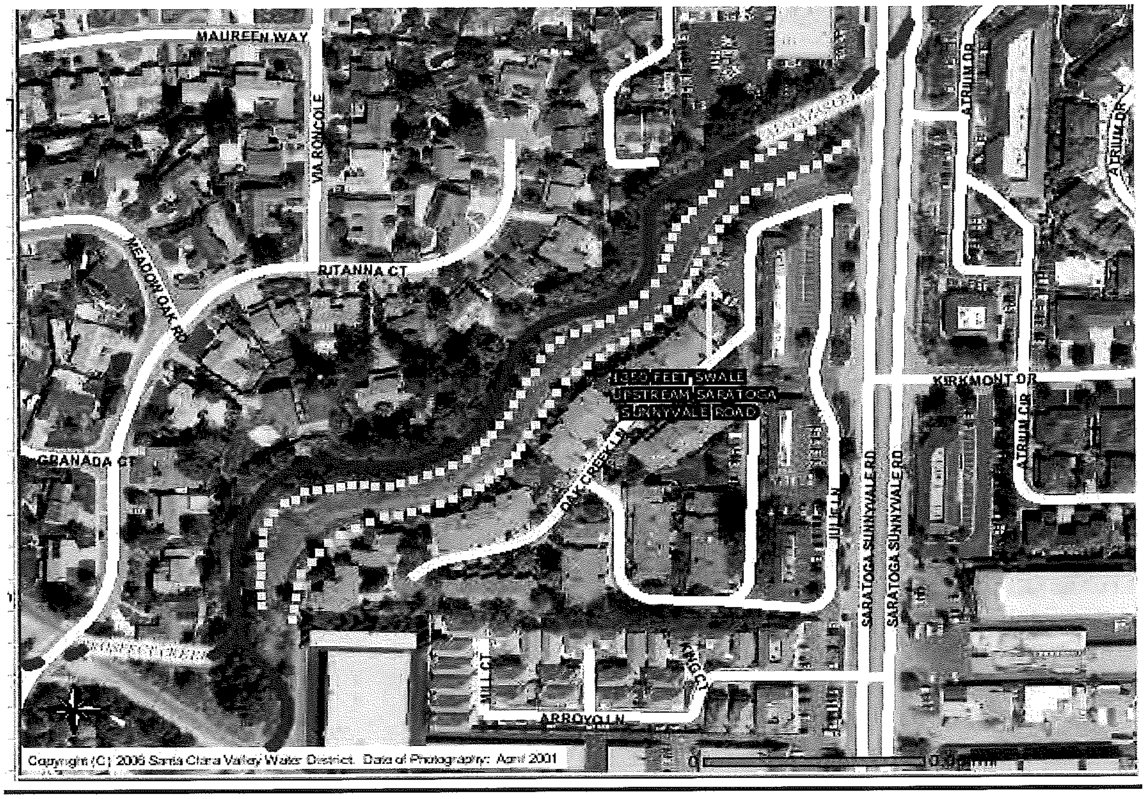
Construction of "Alt 3D" will protect the Coldwell Banker Blue Hills parking lot from flooding. Construction will also have temporary traffic impacts and possible temporary loss of parking for local businesses, potential impact to existing trees, as well as temporary noise and dust impacts during construction. City of Saratoga might be involved for the construction of floodwall at downstream end of the swale.

Swale detention would need regular maintenance for its inlet / outlet works. The detention basin itself would need minimal maintenance, as vegetation and sediment can be allowed unchecked. Existing O&M activities around the swale area are expected to continue within the project limits. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal will remain the same. Some additional maintenance activities would be required for floodwalls at downstream end of the swale for graffiti removal.

Swale Looking Upstream



Nts: Typical Cross Section Looking Upstream



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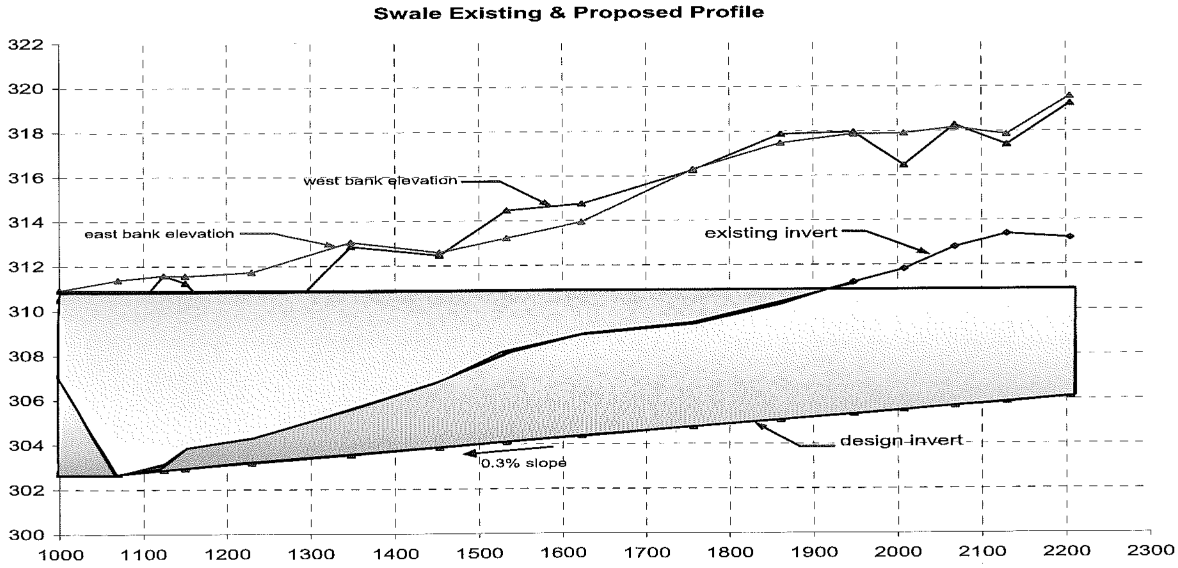
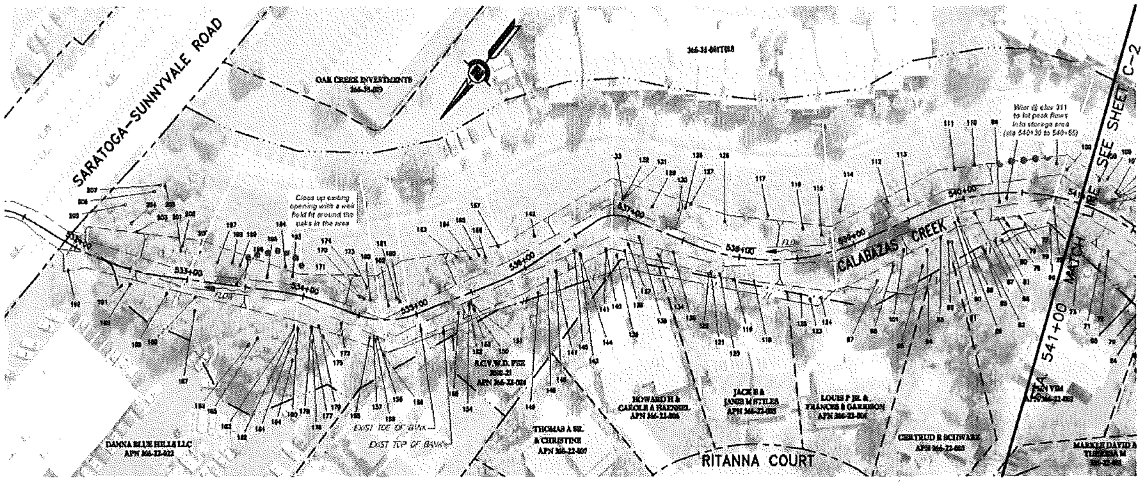
Plan View

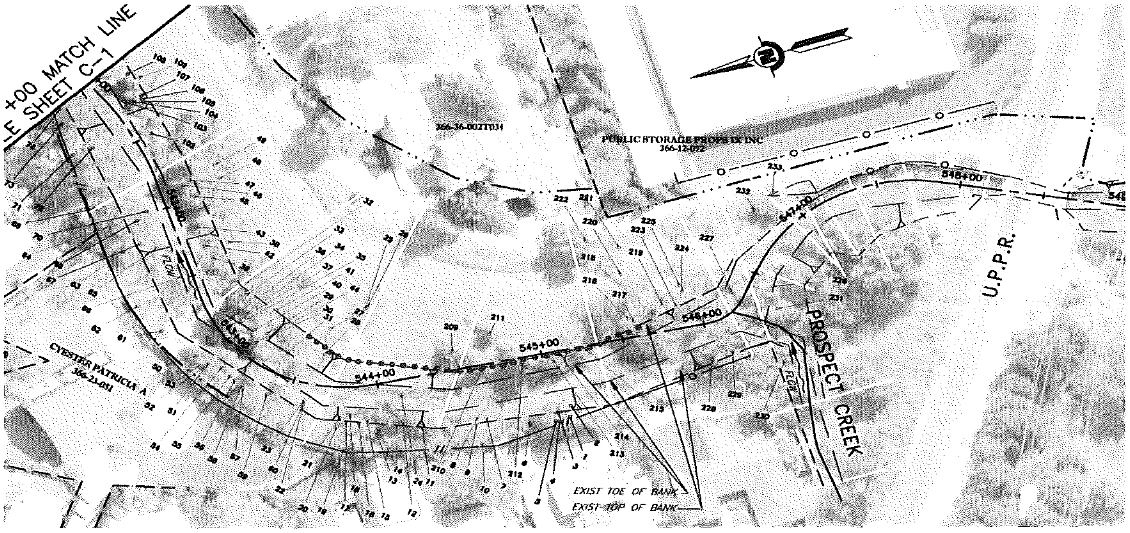


Swale Existing and Proposed Invert

PROPOSED WEIR FOOTPRINTS



PROPOSED WEIR FOOTPRINT



Alt 3E: Swale Detention and Tunnel Modification

An 80-foot long entrance section of the existing concrete tunnel will be rebuilt as an enlarged reinforced concrete box (RCB) to improve flow efficiency and reduce upstream water depth.

The new, enlarged RCB section will be a 10-foot high by 16-foot wide box. This new section (from Station 531+22 to Station 531+94) will be constructed along the same alignment of the existing tunnel under Saratoga-Sunnyvale Road. An 8-foot long transition (from STA 531+14 to STA 531+22) will connect the enlarged RCB to the existing 9-foot by 12-foot tunnel.

The new RCB section will have the same slope (around 1.14%) as the tunnel downstream of STA 531+14. This smooth, steep slope ensures a high-velocity, low-depth flow in the box. The entrance of the new RCB will be rounded at the soffit.

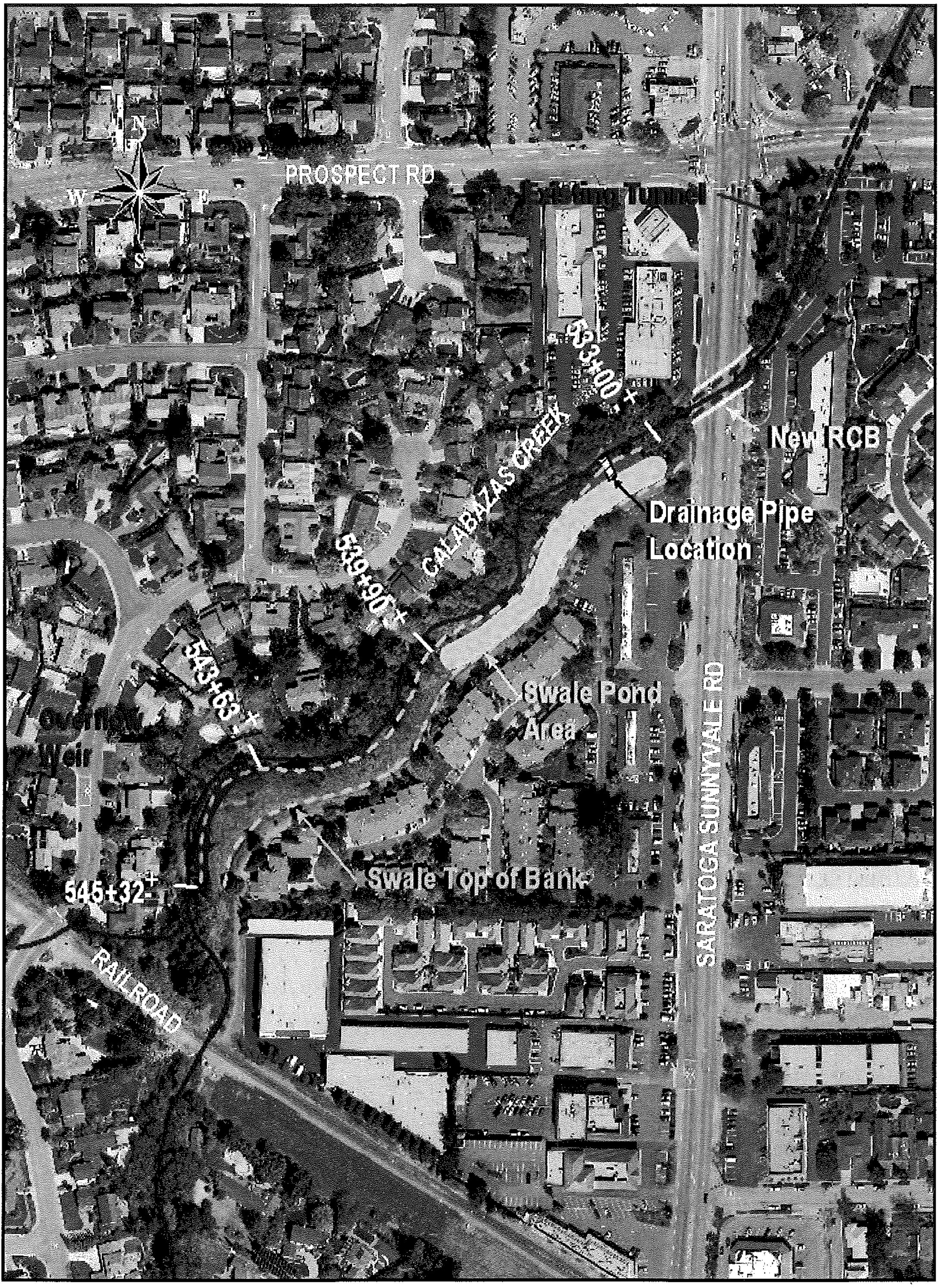
The channel upstream of the new RCB entrance will be covered by rip-rap to protect it from erosion due to the increased velocity at the box inlet. The rip-rap cover is suggested to extend around twice the box height (or 20-feet in length).

A 170-foot long overflow weir (STA 545+63 to STA 543+32) will be placed on the left bank (looking upstream) of Calabazas Creek to divert any flow above 1,350 cfs into the existing swale. Some openings in the existing swale will be blocked (and raised to an elevation of at least 308.6 ft) in order to convert the swale into a detention basin of capacity one acre-ft at maximum water surface elevation of 308.6 ft.

A drainage pipe, of one-foot diameter, will connect the detention basin with the creek by crossing the levee. The pipe will drain the detention basin water by discharging it into the creek. The pipe will be placed at STA 533+95 and will have a flap gate at its outlet. The invert of the pipe entrance will be placed at the lowest point in the detention basin.

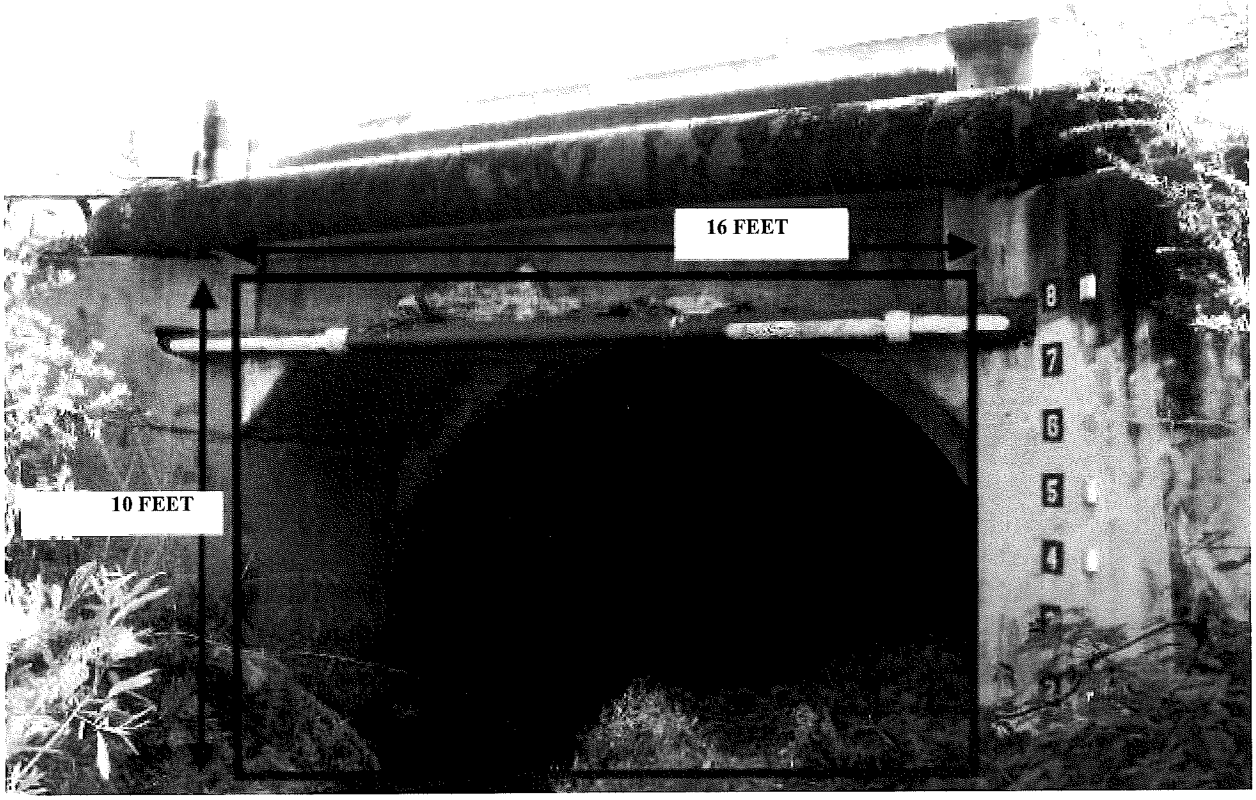
Construction of "Alt 3E" will benefit the business and residential areas upstream and southwest of Saratoga-Sunnyvale Road. Construction work will temporary impact traffic and possibly cause a temporary loss of parking places for local businesses. Existing trees will be impacted and the area will definitely experience temporary noise and dust impacts during construction.

Operation and maintenance of the enlarged RCB section would be minimal. Although the new section would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season. Swale detention would only need regular maintenance for its inlet / outlet work. The detention basin itself would need minimal maintenance, as vegetation and sediment can be allowed unchecked. Existing O&M activities around the swale area are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal will remain the same.

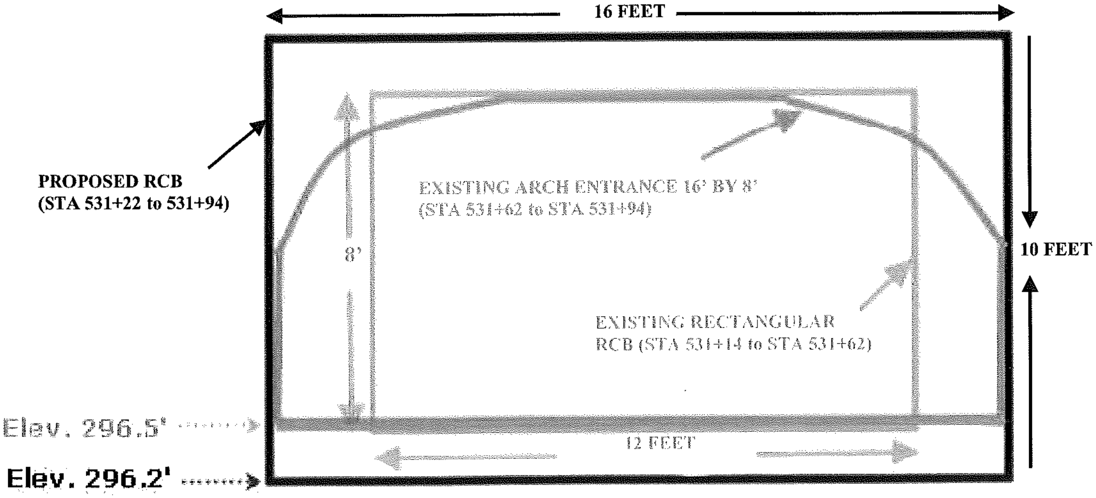


Maria - C:\Calabazas\Basemprospect aerial

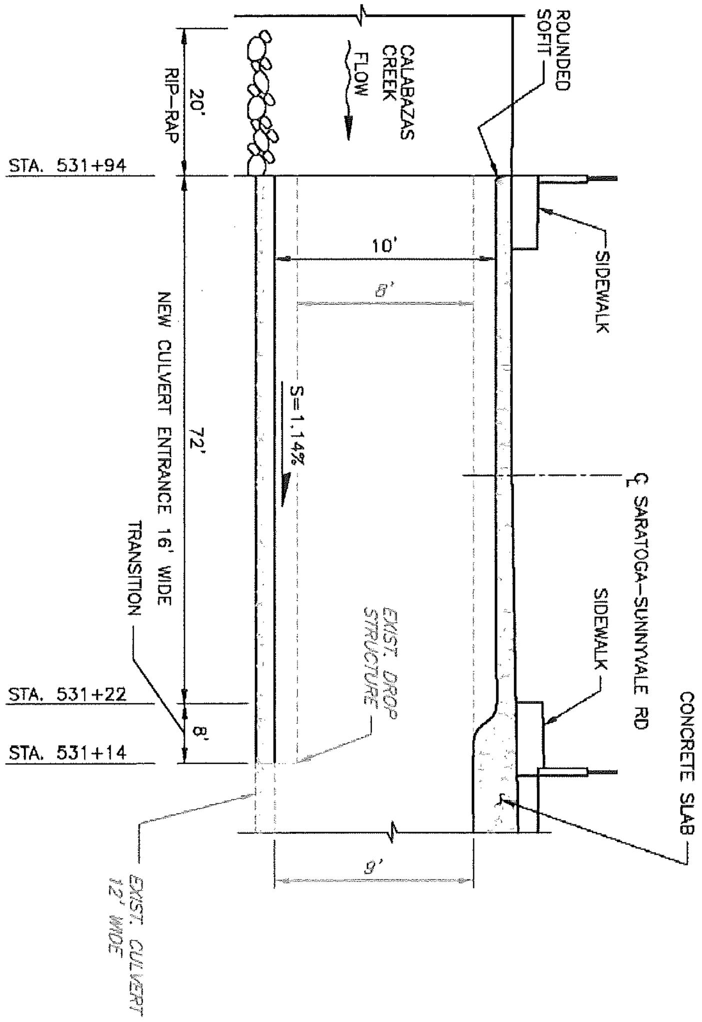
Plan View



Looking Downstream, Saratoga-Sunnyvale proposed 80' long RCB



NTS: Typical Section of Proposed RCB (STA 531+22 to STA 531+94),
Existing Arch Entrance and Existing Rectangular RCB


ROUNDED SOFIT
CALABAZAS CREEK
FLOW
20'
RIP-RAP
STA. 531+94
SIDEWALK
10'
8'
NEW CULVERT ENTRANCE 16' WIDE TRANSITION
72'
S=1.14%
℄ SARATOGA-SUNNYVALE RD
SIDEWALK
CONCRETE SLAB
EXIST. DROP STRUCTURE
STA. 531+22
8'
STA. 531+14
9'
EXIST. CULVERT 12' WIDE

Site 4: Union Pacific Railroad (UPRR) bridge

Alt 4A: Underground RCP Bypass

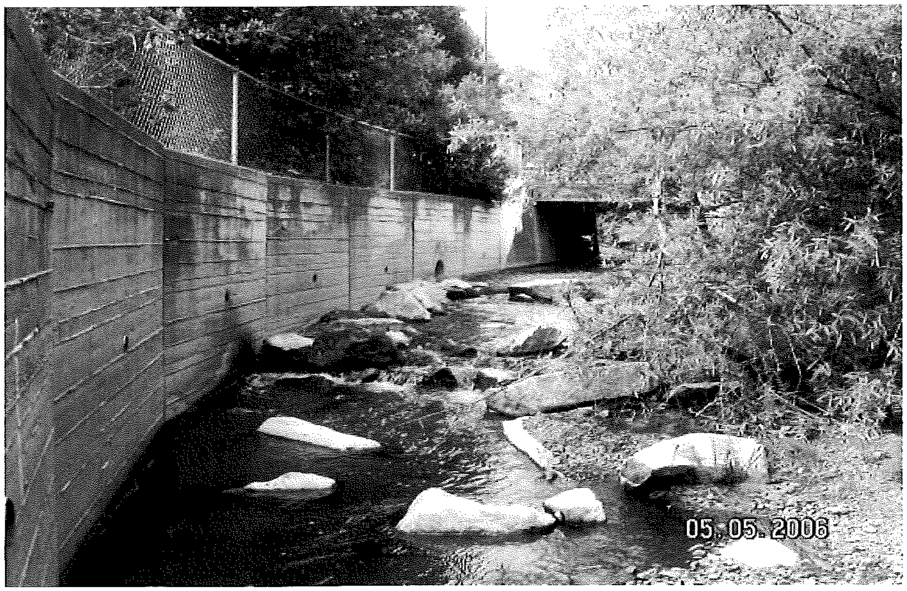
An underground bypass provided by an 84" reinforced concrete pipe (RCP) (approx. STA 547+68 to STA 549+80) would be constructed along the creek bank.

To prevent flooding upstream of the UPRR bridge during high flow events, an underground RCP bypass would be constructed along the creek west bank from upstream of UPRR to the downstream of UPRR under residential backyards. Bypasses are appropriate where environmental features or access problems prevent enlargement or improvement of the existing bridge, creek, or other structure which would allow it to contain the design flow. The proposed RCP bypass will route excess flows around the problem area and reintroduce them to the channel further downstream. The new RCP bypass would be approximately 220 feet long and able to carry 520 cfs (the difference between existing capacity and 1% design flow).

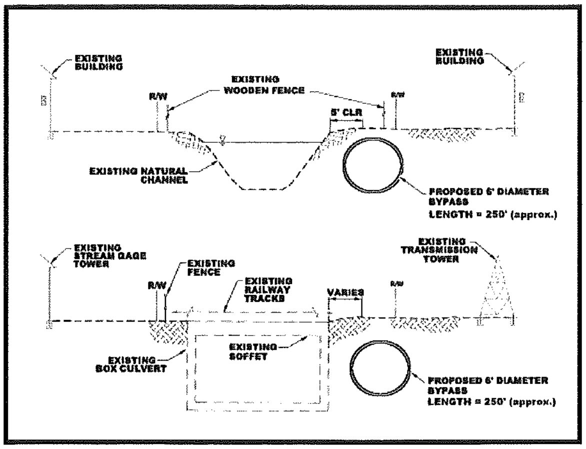
It is expected that the new RCP bypass would be constructed within UPRR, SCVWD, and resident easements. Construction and installation would be completed in 1 year depending on difficulties with Railroad Company and possible land acquisition from residents.

Construction of "Alt 4A" will benefit the Railroad and residents upstream of UPRR bridge. Construction work will temporarily impact Railroad operation, will have right-of way impact, and will definitely result in temporary noise and dust impacts during construction.

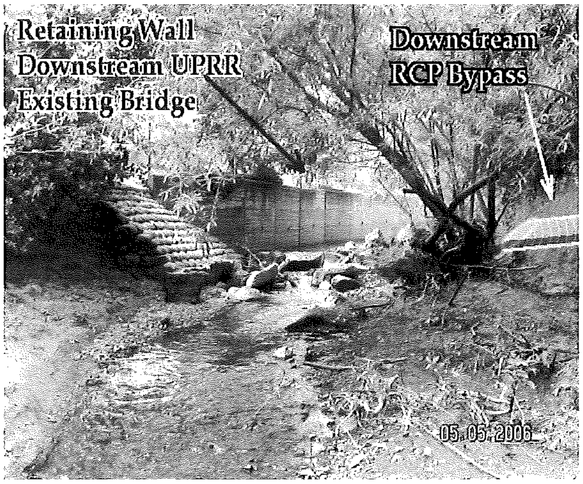
Operation and maintenance of the RCP bypass would be minimal and would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.



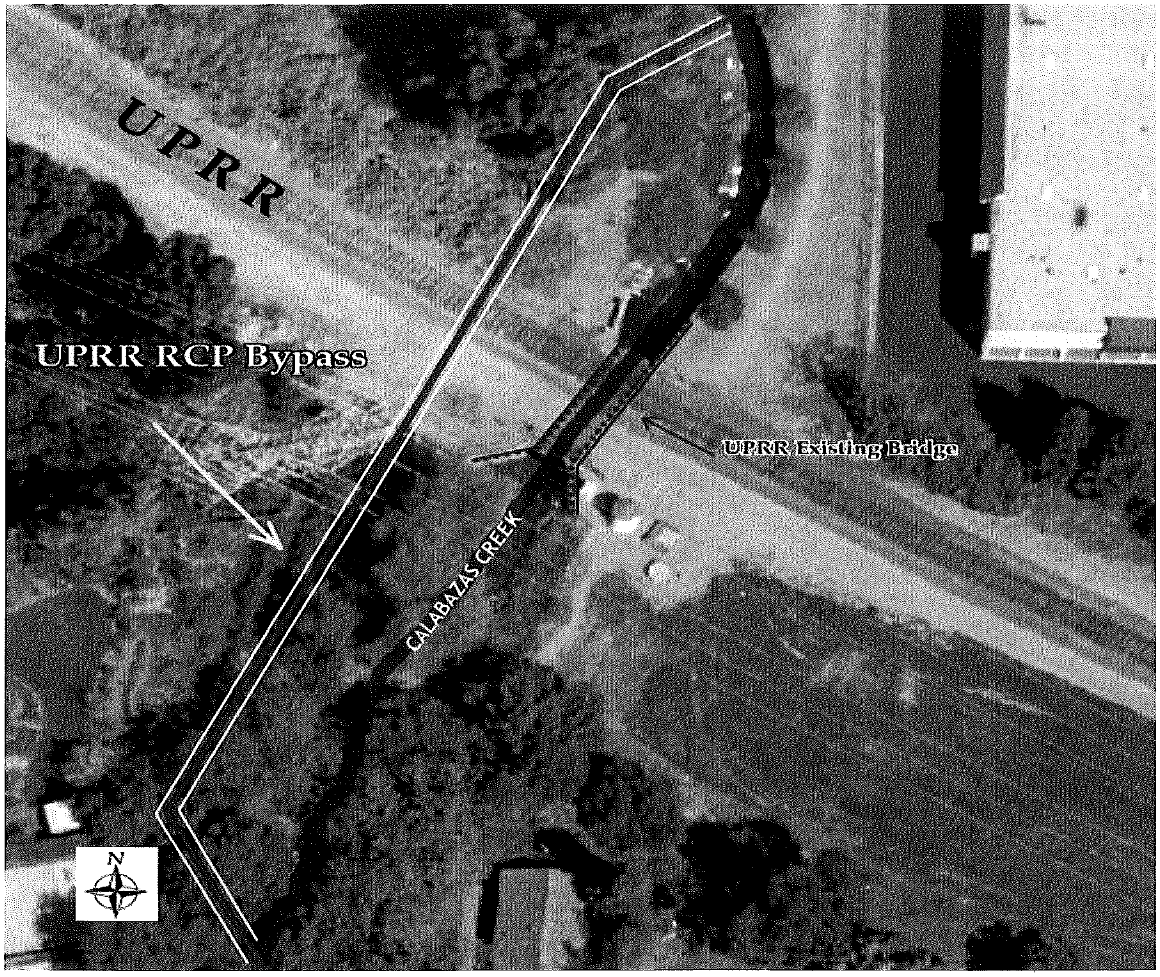
Looking Upstream



Looking Upstream



Looking Upstream



Plan View

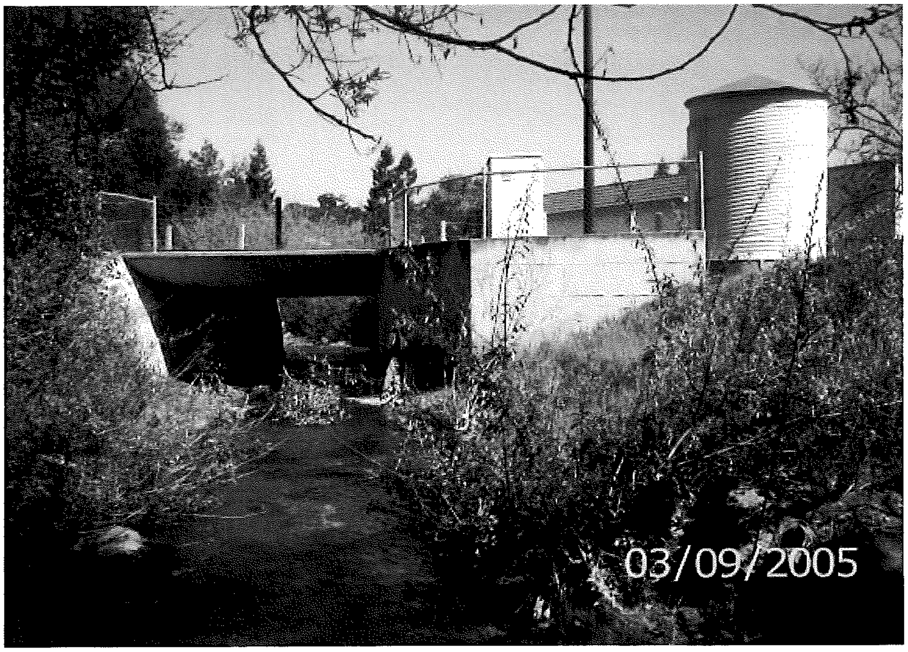
Alt 4B: Bridge Replacement

The existing 6-foot high by 13-foot wide (average width) UPRR crossing consist of a U-frame concrete channel covered by an old railroad clear span bridge made out of large heavily treated wooden beams. The 35 foot long channel opening under the existing UPRR bridge varies in width from 14.5 feet on the upstream face to 11.5 feet at the downstream face. This element consists of replacing the existing wooden bridge with a 7-foot by 12-foot (uniform height and width) bridge between approximately STA 548+28 to STA 548+63.

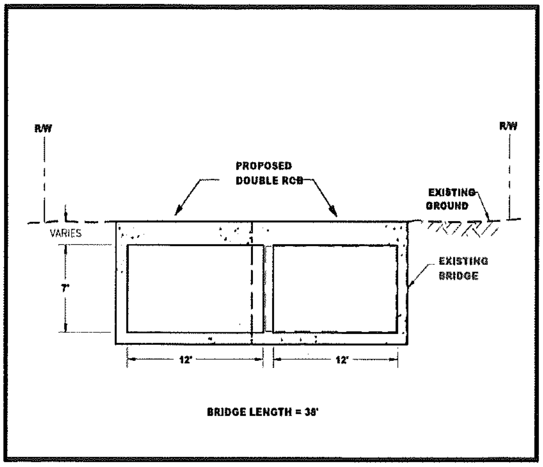
The construction work would be done within District and UPRR easements. The existing bridge would be demolished and reconstructed as a double RCB. Construction is expected to last 1 year.

Construction of "Alt 4B" will benefit the Railroad and residents upstream of the Union Pacific Railroad. Construction work will temporary impact railway traffic, and include the expected noise and dust impacts during construction. Time and expense for coordination with the Railroad would be of concern.

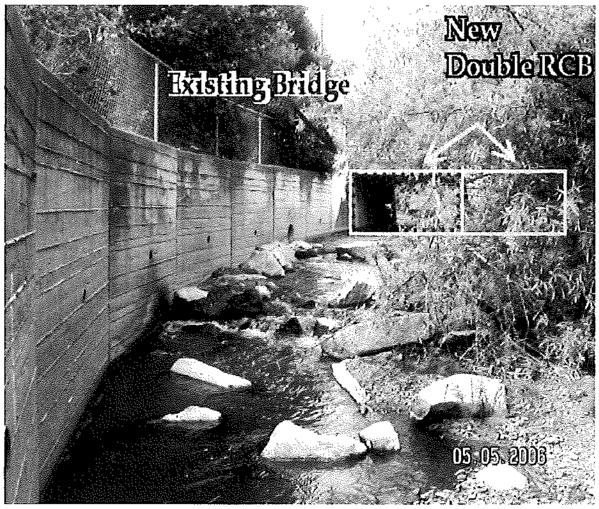
Operation and maintenance activities for the double RCB would be similar to existing bridge and would be designed to have adequate slope for sediment passage.



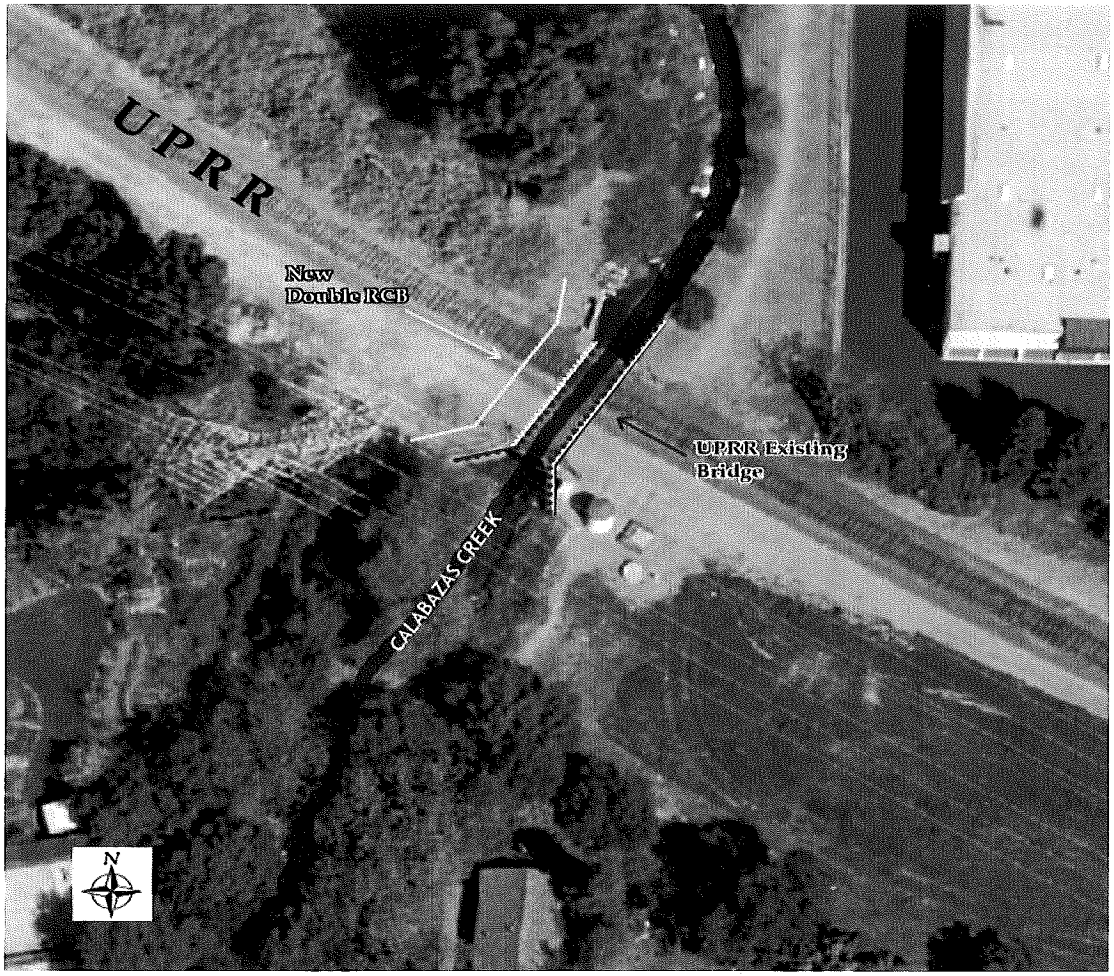
Looking Downstream



Looking Downstream



Looking Upstream



Plan View

Alt 4C: Floodwall

Floodwalls would be built on both banks upstream of UPRR existing bridge (approx. STA 548+63 to STA 554+69.5).

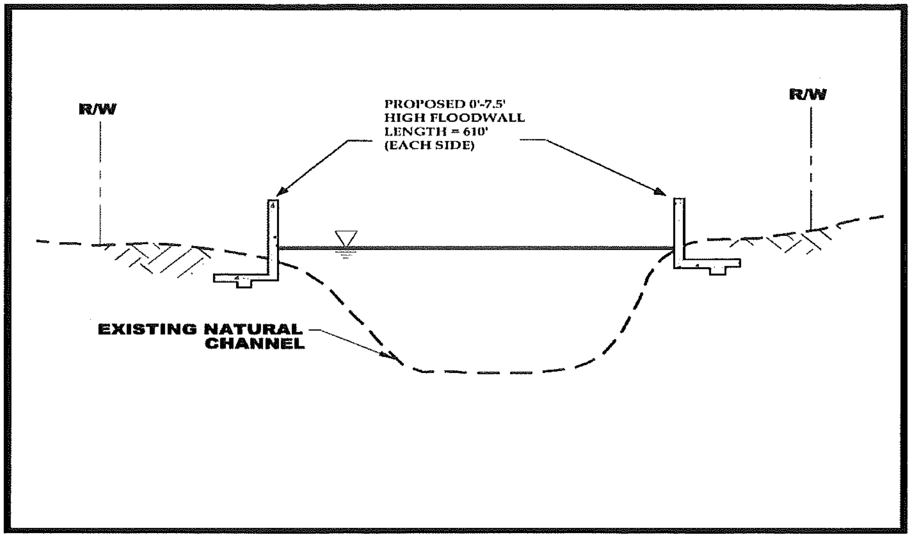
Creek geometry along this section can be described as a natural trapezoidal earthen channel. Implementation of "Alt 4C" would eliminate flooding u/s of UPRR through containment of the 1% design flow. To prevent the channel from flooding at this location, floodwalls of approximately 0-7.5 foot in height would be installed along the top of both sides of the channel (east and west banks). The increase in channel height will enlarge the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Construction of "Alt 4C" will benefit the residents upstream of the Union Pacific Railroad .

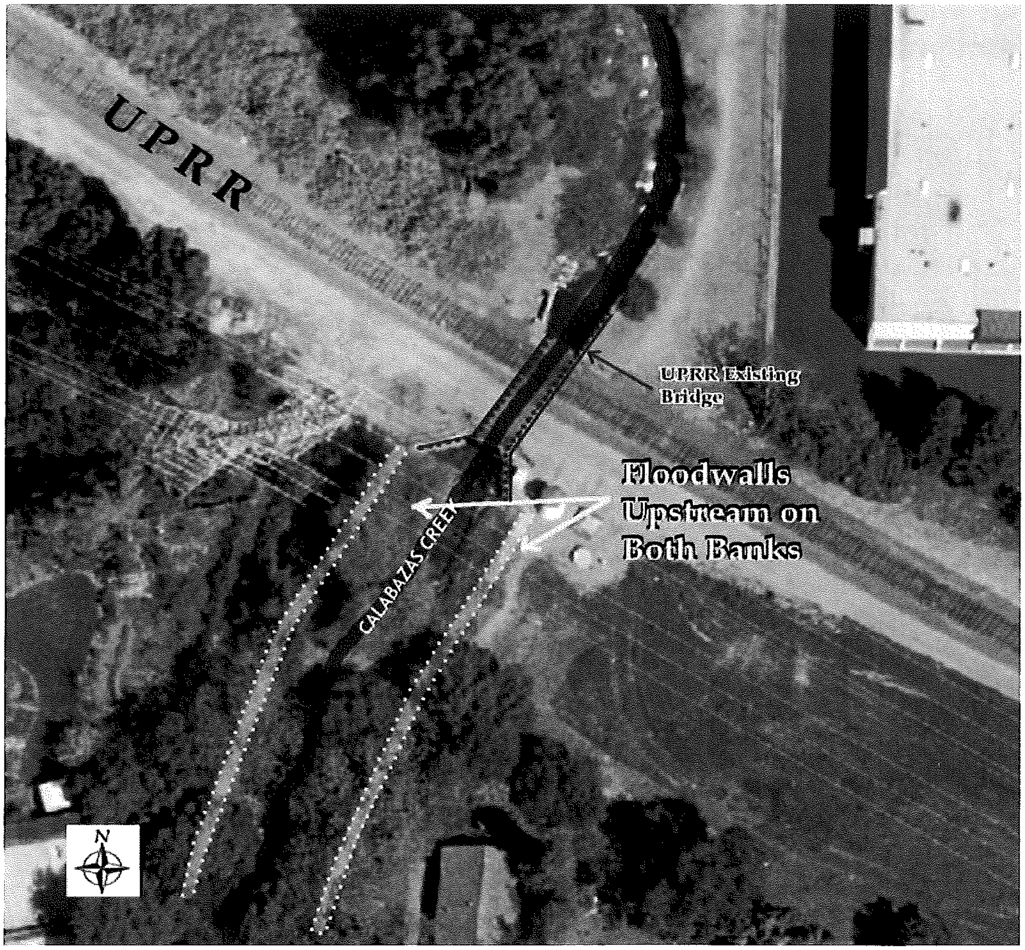
Existing trees and animal movement will be impacted and the area will definitely experience temporary noise and dust impacts during construction.

Most existing operating and maintenance activities are expected to continue at the same level within the project limits. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal will remain the same. Graffiti problems and associated additional maintenance work may increase due to the presence of these large concrete walls.

Looking Upstream-Upstream of UPRR



Looking Upstream



Plan View

J

APPENDIX J

Comer Dam modification alternatives

Calabazas Creek
Miller Avenue to Comer Drive

Comer Dam Vicinity

Overview and Sediment Transport Analysis

by

Emily Zedler, Assistant Engineer II
Liang Xu, Senior Engineer

October 2006

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Overview

The Comer Debris Basin is located on Calabazas Creek just downstream of Comer Drive Bridge. The District has identified three main feasible alternatives for replacing the Dam. See the summary of the three alternatives on page 33 of the Main Report.

Sediment Transport Introduction

Located just downstream of Comer Drive Bridge on Calabazas Creek, Comer Debris Dam was constructed in 1973. The dam is about 13 feet deep and extends a distance of roughly 35 feet along-stream, inclined downstream at an angle of about 20 degrees to the horizontal. The bottom 7 feet of the dam (and more than half of its along-stream distance) was covered with a mixture of rocks and sediment to conform to the existing bed such that only part of the dam was exposed. Between 1973 and 1992, the reach immediately upstream of the dam and beneath Comer Drive Bridge was routinely excavated to serve as a sediment trap for the high sediment loads carried from upstream. During this time, significant erosion was occurring on the downstream face of the dam such that the invert dropped an additional 7 feet and the entire length of the dam became exposed. After 1992, when the District halted its maintenance program, the channel in the vicinity of Comer Debris Dam reached a state of quasi-equilibrium. Although stable, the reach of creek around Comer Drive Bridge has decreased the depth of the opening under the bridge from about 10 feet to about 4 feet (Kennedy/Jenks 2002), which has raised community concerns about bridge overtopping during large storm events. In addition, the Dam is not aesthetically pleasing, provides poor habitat for vegetation, and makes the creek less accessible to the public for recreation as there is a deep, steep drop at the dam face.

In response to these concerns and others, the District has identified three main conceptual alternatives for replacing the Dam:

Alternative 1: The Dam is replaced completely with a section of channel of constant slope. District analysis concludes that the 'most stable' channel configuration would have a slope of about 1.3% and would extend from just upstream of Wardell Rd. to about 600 feet upstream of Comer Drive Bridge, a total of about 2700 feet.

Alternative 2: The Dam is replaced by a series of rock weirs or drops. The feasible design of this alternative includes 10 drops ranging in depth from 0.8 to 1.2 feet and in length from 60 to 170 feet. The slope between drops would be designed to be 1%, matching that in the reach immediately upstream of the project reach. About 750 feet of channel would be impacted in construction of Alternative 2.

Alternative 3: The Dam is partially removed. In this scenario, the top 5.6 feet of the existing dam would be removed. A stable slope of 1.25% would be established upstream of the dam. The impacted area would include about 500 feet of channel.

These conceptual alternatives were roughed out in a 2002 study by Kennedy/Jenks Consultants. This document summarizes the development of each conceptual alternative into a feasible one. This process involves several steps, including 1) the determination of stable channel cross-sectional shape for each alternative, 2) calibration of the model for the existing conditions, 3) development of an initial HEC-RAS model for each alternative to serve as the hydraulic inputs for the sediment transport analysis, and 4) iterative adjustment of the HEC-RAS geometry until sediment transport patterns produce a stable invert profile for the project reach.

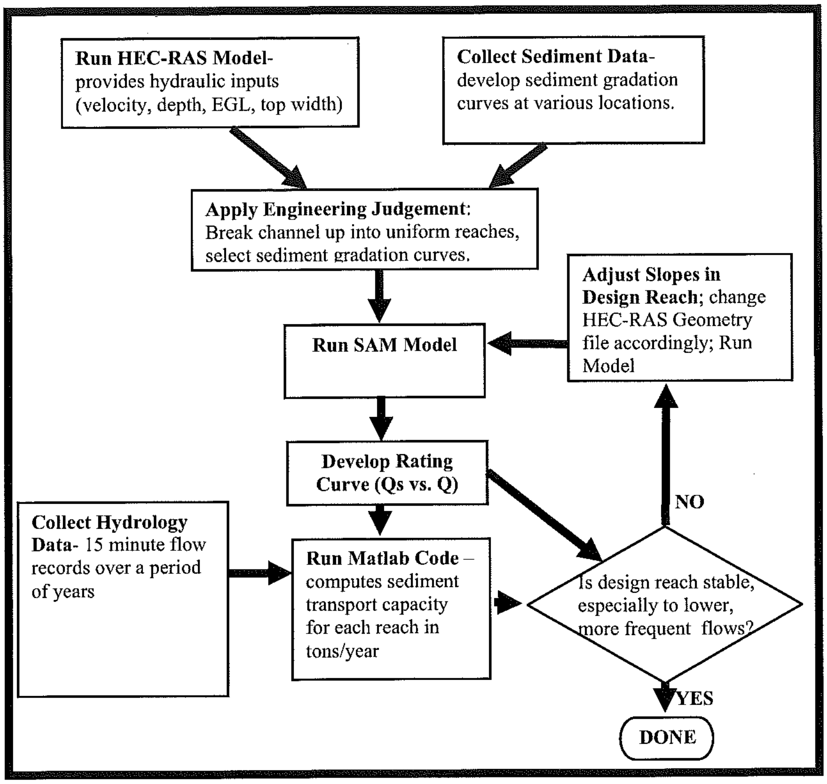
This document is organized into 6 sections, describing 1) the procedure for the sediment transport analysis, including necessary inputs, 2) selection of the inputs for this analysis, based on data collected and a calibration of the model for the existing conditions, and 4), 5), and 6) development of the feasible alternatives 1, 2, and 3, respectively.

1. Sediment Transport Analysis Procedure

The procedure for designing a stable invert slope for a reach of creek is summarized in Flow Chart 1.1 below.

Inputs for this analysis include sediment gradation curves representative of the reaches of interest, a HEC-RAS model of the creek, and either historical flow records (in this case) or a flow frequency analysis. The HEC-RAS model should extend a distance upstream and downstream of the project reach such that the sediment transport capacity of the surrounding reaches can be adequately computed (i.e., boundary conditions should be far upstream and downstream of the project reach).

Essentially, the procedure involves performing iterations between adjusting the slope(s) of the project reach (in the HEC-RAS model) and performing the sediment transport analysis until a balance of the sediment transport capacity is achieved between the project reach and the reaches immediately upstream and downstream of it. These reaches are defined by the engineer to contain relatively uniform geometry and hydraulics, so that the standard deviation of a given hydraulic parameter (e.g., velocity) is small within a reach.


Run HEC-RAS Model- provides hydraulic inputs (velocity, depth, EGL, top width)
Collect Sediment Data- develop sediment gradation curves at various locations.
Apply Engineering Judgement: Break channel up into uniform reaches, select sediment gradation curves.
Adjust Slopes in Design Reach; change HEC-RAS Geometry file accordingly; Run Model
Run SAM Model
Develop Rating Curve (Qs vs. Q)
NO
Collect Hydrology Data- 15 minute flow records over a period of years
Run Matlab Code – computes sediment transport capacity for each reach in tons/year
Is design reach stable, especially to lower, more frequent flows?
YES
DONE

Flow Chart 1.1 Describes the procedure for performing the sediment transport analysis.

2. Development of Inputs for Design of Feasible Alternatives

As mentioned in Section 1, several inputs are necessary for development of feasible alternatives at Comer Debris Basin. In this section, we present the results of the existing conditions calibration case. The calibration case is necessary for ensuring that our inputs to the sediment transport model are reasonable. Here, inputs include the division of the channel into hydraulically-uniform sub-reaches, the sediment gradation curves used for each reach and the flow data used for computing the annual sediment yield estimates. The calibration case also determines the sediment transport equation that will be used in the modeling process through comparison of results for different equations with known data (sediment removal data, in this case).

In addition, in order to generate stable geometry files for the three alternatives, it is necessary to identify a stable, geomorphic cross section shape that can be used for the new channel geometry in the HEC-RAS files. The important cross section parameters, determined from a site visit, are also presented in this section.

2.1 Existing Conditions: Calibration Case

2.1.1 Flow Data

Six years of recent historical flow data recorded at the Wilcox gauge station between 1999 and 2004 were used in this analysis. Calabazas Creek is dry most of the year, and the flow records are flashy. Figure 2.1.1.1 plots the non-zero flows for each water year. The data are plotted as flow rate in cfs vs. time in days as recorded at Wilcox gauge station, where zero flow rates (occurring most of the time) have been removed from the record so that the data are treated as continuous hydrographs, even though the flow data are not contiguous. Since the project reach (i.e., surrounding Comer Debris Basin) is located far upstream of Wilcox gauge station, the flow rates have been reduced accordingly by a factor of about 0.28. This adjustment factor is the ratio between District hydrology predictions of the 10-year flow event magnitude near Comer Debris basin to the value near Wilcox.

As will be shown later in the calibration case, these 6 years of flow data yield reasonable estimates of the sediment transport capacity in the reach upstream of Comer Debris Basin relative to available sediment removal data there.

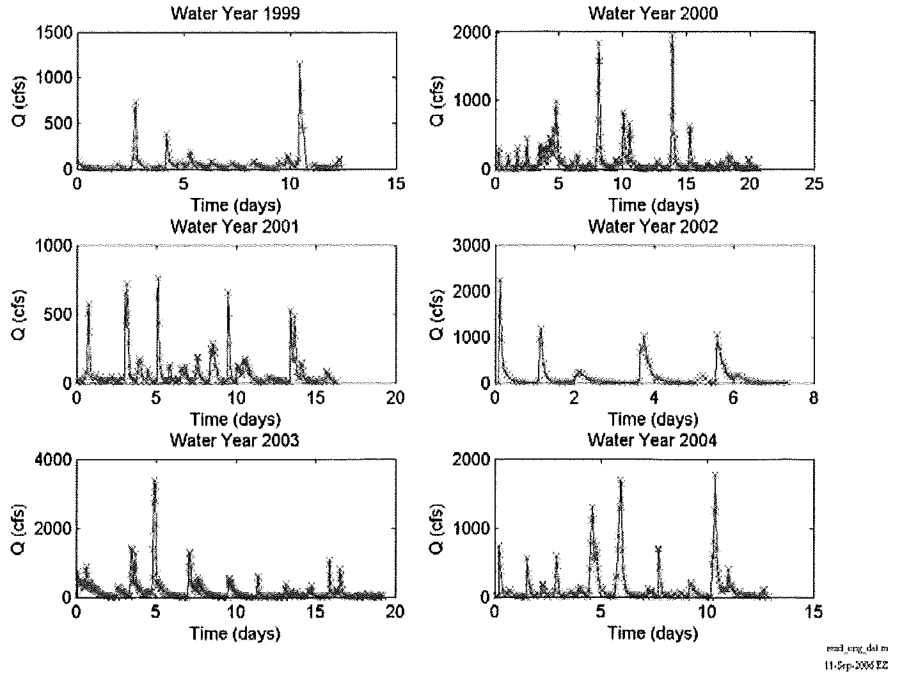


Figure 2.1.1.1 Flow Data at Wilcox Gauge Station for water years 1999 – 2004. Zero flows have been removed from the record, which is treated as a continuous flow record for the purposes of our sediment transport analysis.

2.1.2 Sediment Data

Sediment samples were collected in the vicinity of Comer Debris Dam in November of 2005. The sites were spaced anywhere from 200 to 1200 feet apart. At each sample site, three samples were collected- one from the armoring layer, one from the pond, and one from the subsurface layer beneath the point bar. Six samples between Wardell Rd. and Padero Rd. Bridges were used in the sediment transport analysis.

As explained in the section 1, the sediment transport analysis involves computation of and comparison between the sediment transport capacity for each reach. This procedure includes selection of a representative sediment gradation curve for each reach. After considerable deliberation, the project team decided to use a single sediment gradation curve for the sediment transport analysis in all of the reaches.

The final sediment gradation curve used was computed as the average of the seventeen bags of sediment collected for the six samples used in the analysis (three samples at each of the six sites except for one, which lacked an armoring layer). Figure 2.1.2.1 shows the sediment gradation curves sampled for the six sites, plotted together with their curve average. Figure 2.1.2.2 shows the average for each of the six samples on the same figure along with their average. The sediment gradation curve used in this study- the average of all 17 samples- is the solid blue line with circle markers in Figure 2.1.2.2.

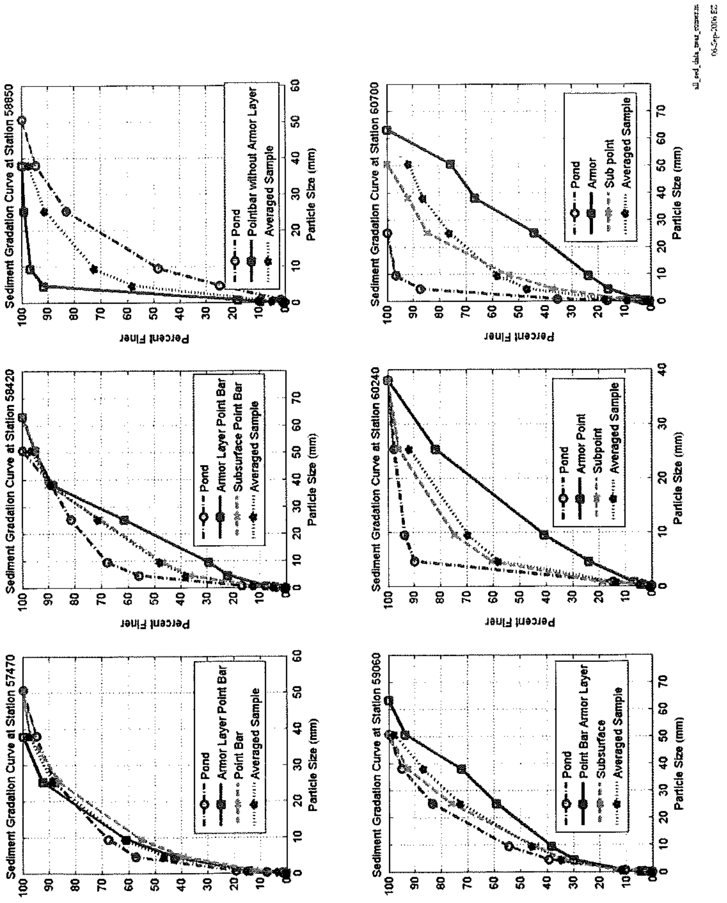


Figure 2.1.2.1 Sediment samples collected at various stations along Calabazas Creek, in the vicinity of Comer Debris Dam.

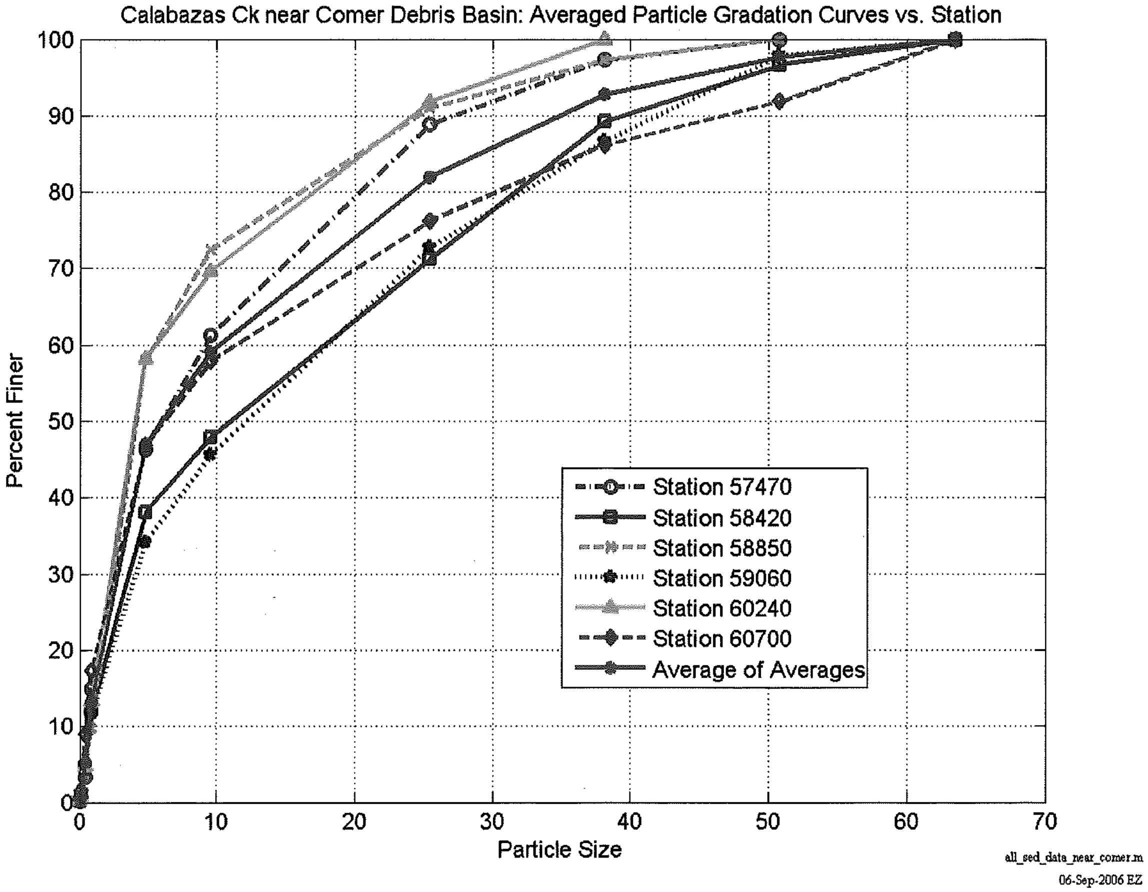


Figure 2.1.2.2 Averaged sediment profiles at 6 stations near Comer Debris Dam. The "average of averages" (i.e., the average of the 17 samples collected near the project site) profile was used in calculations of sediment transport capacity for each reach of channel.

The decision criteria for selecting the sediment gradation curve formed by averaging the 17 samples between Wardell Rd and Padero Rd. for the sediment transport analysis were:

1) There was no discernible pattern in the way that sediment size varied with distance downstream.

2) For each sample site, three samples were collected from regions with different particle characteristics (i.e., one each from the armoring layer, the pond, and the subsurface below the point bar). There is a reasonable chance that these samples were not statistically representative of the material at that site.

3) The sediment gradation curves are used to estimate the total sediment moved over a number of years. For this long time period, use of a mixture of sediment samples from the armoring layer, the pond, and the subsurface region below the point bar seems reasonable.

4) The selected sediment gradation curve, along with the choice of the Toffaleti-MPM method, produced sediment transport capacity values in the Reach upstream of Comer Drive which matched well with sediment removal data. See the Section 2.1.4 for more information.

2.1.3 Existing Conditions: Division of Channel into Hydraulically Uniform Reaches

We begin with a description of the length of channel located between Wardell Rd. Bridge at its downstream end and Padero Rd. Bridge at its upstream end, which is the extent of the HEC-RAS model used in this analysis. This reach both extends between two control structures and is sufficiently large to characterize the areas downstream and upstream of each alternative. The length of this reach is about 4500 feet long, or about 0.85 miles. Comer Debris Dam is located about halfway through the reach. There are two bridges within this reach- Comer Drive Bridge, located about 200 feet upstream of Comer Debris Basin, and a Foot bridge, located about 1100 feet upstream of Comer Drive Bridge.

The slope, channel roughness, and cross section shape vary considerably in the reach extending from Wardell Rd. Bridge at its downstream end to Padero Rd. Bridge at its upstream end. For the purposes of simplifying the sediment transport analysis, this reach has been broken up into five sub-reaches with relatively constant slopes, channel shape, and roughness characteristics- three downstream and two upstream of the dam. The reaches are outlined in Figure 2.1.3.1 and their major characteristics are summarized in Table 2.1.3.1 below. These sub-reaches, referred to herein as Reaches 0-4, were used in the existing conditions calibration case. The hydraulic inputs from each were averaged and input into SAM for computing the sediment rating curves.

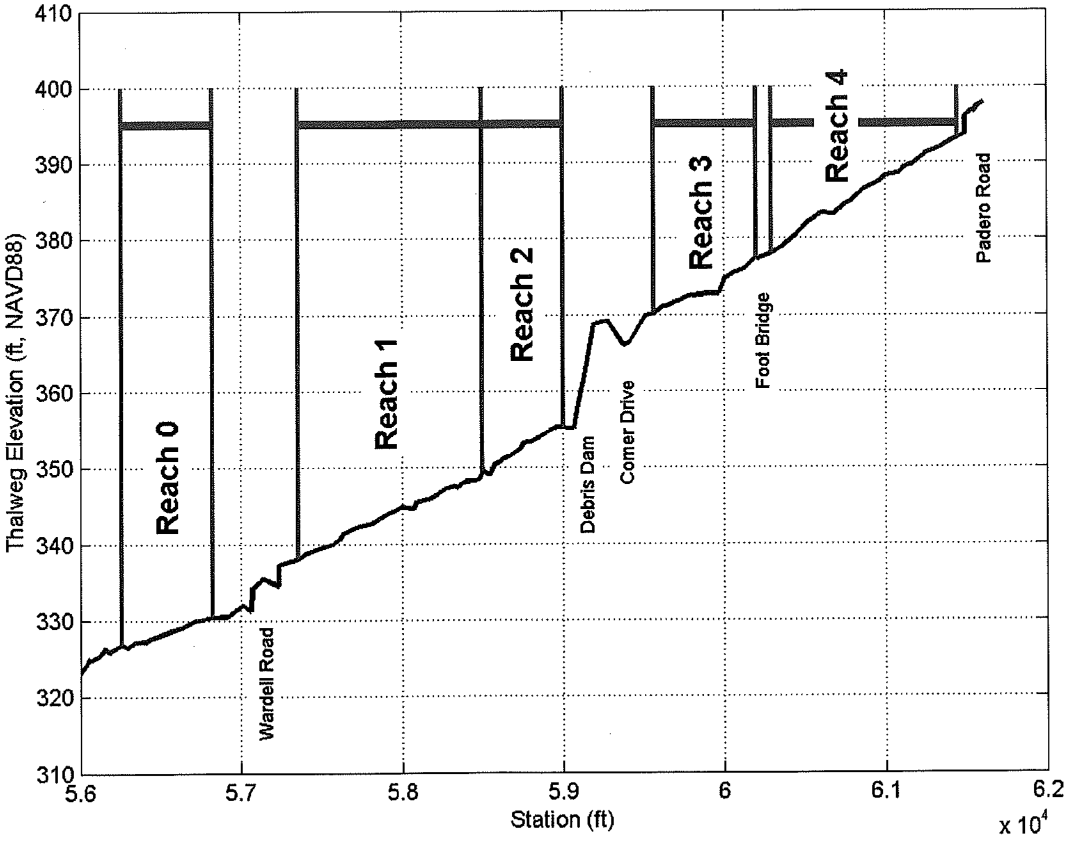


Figure 2.1.3.1 Definition of reaches 0- 4 relative to the thalweg profile for the existing conditions. Thalweg elevation data were obtained from the 2006 HEC-RAS model.

Table 2.1.3.1 Characterization of Channel Geometry in Reaches 1-4

	Length of Reach (Ft)	Average Percent Slope of Reach (ft/ft)*100 %	Description of Channel Cross Section Shape	Roughness of Low Flow Channel
Reach 0	560	0.7 %	Cross sections are uniform, narrower than Reach 1, and deep. 100-year flow is contained	n ~ 0.036
Reach 1	1140	0.9 %	Similar to Reach 2, but less incised	n ~ 0.03 – 0.047
Reach 2	500	1.3 %	Somewhat incised, well vegetated	n ~ 0.04 – 0.047
Reach 3	630	1.1 %	Wide flood plain (relative to Reach 4 upstream)	n ~ 0.034
Reach 4	1150	1.3 %	Deeper and narrower than Reach 3	n ~ 0.034

2.1.4 Calibration for Existing Conditions- Selection of a Sediment Transport Function

The SAM package includes 20 different sediment transport equations. Although several were developed for computing sediment transport in gravel bed streams, we tested only the MPM (bedload only) and MPM-Toffaleti (combined bed- and suspended load) methods, because the MPM method produced reasonable results in previous calculations of the sediment transport rate in Calabazas Creek between Miller Avenue and Homestead.

The sediment transport capacity values averaged over the six years of flow data for each reach are given in Table 2.1.4.1 below. Not surprisingly, the two related methods produce different magnitudes, since the MPM method computes only the bedload whereas the MPM-Toffaleti computes the combined bed- and suspended load. However, they produce similar patterns from reach to reach, since they were given the same hydraulic inputs. Essentially, the transport capacity increases with distance upstream.

Table 2.1.4.1 Computed Values of Average Annual Sediment Transport Capacity (tons/year) using Different Sediment Transport Equations. Values are rounded to the nearest 5.

Reach Identified	Sediment Transport Capacity MPM (1948), tons/year	Sediment Transport Capacity MPM-Toffaleti, tons/year
Reach 0	1580	5055
Reach 1	2010	5850
Reach 2	2540	6610
Reach 3	[redacted]	[redacted]
Reach 4	3415	9225

Apart from conceptual understanding of sediment transport patterns arising from observation of erosion and deposition over the years, the main data available for calibration of the sediment transport capacity model are found in maintenance records of sediment removal data for Comer Debris Basin. Sediment was removed from the basin in 1974, 1975, 1978, 1982, 2983, 1985, 1986, 1990, 1991 and 1992 before maintenance was halted. After each removal, the excavated area was filled back up with sediment from upstream. Thus, the amount of sediment removed annually (expressed as tons/year) at the Debris Basin represents a lower limit on the sediment *transported* annually by the reach upstream of Comer Debris Basin, which, in turn, is a lower limit to the annual sediment transport *capacity*.

Annual sediment removal rates at Comer Debris Basin range in value from about 2200 tons/year in a dry year to a maximum value of 13,700 tons/year in a wet year. The average value over the 10 years of data is about 5600 tons/year (Kennedy/Jenks 2002). The results presented in Table 2.1.4.1 are analyzed by comparing annual removal rates at Comer Debris Basin with the average annual capacity for Reach 3, located just upstream of Comer Debris Basin. The transport capacity of Reach 3 represents the upstream supply of sediment for the debris basin. Clearly, the average sediment transport capacity computed for Reach 3 with the MPM method of 2140 tons/year is too low, producing a number which is about 40% of the historical average sediment removal rate by the District of 5600 tons/year. The MPM-Toffaleti equation yields an average annual transport capacity of 6115 tons/year, which is only 10% larger than the annual removal rate.

Kennedy/Jenks 2002 estimated that the sediment supply in Reach 3 should be about 8960 tons/year on average. This estimate is based on a combination of past field measurements of sediment load which showed that sand and gravel constituted about 40% of the total load and the assumption that only sand and gravel were deposited in the debris basin. Both assumptions are reasonable, and the value we show here seems to be about 30% low.

However, this is not the case. The smallest point on the sediment gradation curve entered into SAM was that 0.3% of the sample was finer than 0.07 mm. This resulted in an aggregate sample which, according to SAM, contained only particles which were larger than 0.0625 mm, the cut off for silt. [This has to do with the way SAM parses the entered gradation curve]. For now, we simply note that our estimates of sediment transport capacity include only transported sand and gravel and should, then, be on the order of the sediment removal data estimate of 5600 tons/year, rather than the 8960 tons/year estimated by Kennedy/Jenks. Thus, our calculation of 6115 tons/year of sand and gravel transport capacity, only about 10% larger than the removal rate of 5600 tons/year, is very reasonable.

More work could have been done to determine what percentage of silt and clay comes from upstream of the project reach. This is deemed unnecessary, since a reasonable estimate of the sand and gravel transport rate has been made, and silt and clay particles tend to remain suspended in the wash load. Furthermore, the remainder of the analysis attempts to balance the transport rates between the project reach and its neighboring upstream and downstream reaches- so that differences in this value between reaches are more important than magnitudes.

2.2 Identification of Geomorphic Cross Section: for development of Alternatives at Comer Debris Basin

The shape of the channel cross section in the reach extending very roughly 400 feet downstream of Comer Debris basin differs significantly from the reach of channel extending upstream. Immediately downstream of the debris dam, the channel is well vegetated, somewhat incised, and has a relatively steep slope of about 1.3%. Immediately upstream of the dam, the channel is characterized by less vegetation, a wider floodplain and a milder slope of about 1%. Because of the channel incision downstream (and the locale of the alternatives), the design channel cross section shape was based on channel conditions upstream of Comer Debris Basin, where the channel is natural and stable.

The geomorphic design for the channel cross section shape to be used in the feasible alternatives was based on measurements made in the summer of 2006 of the existing channel dimensions upstream of Comer Dam. Measurements of the bankfull channel- (depth, bottom and top widths) and flood plain- (depth and width) dimensions were made at several locations where a geomorphic, stable channel was identified to have formed. Measurement locations spanned from a distance upstream of Comer Drive Bridge to locations upstream of the Footbridge. In addition, HEC-RAS was run for several flow rates to determine whether one of the flow rates consistently filled the bankfull channel identified in the field. It turned out that the 1.5 year flow event (about 200 cfs) satisfied this criterion reasonably well, which falls within normal range for the frequency of the effective flow rate. After these calculations were performed, District staff calculated the effective discharge for Calabazas Creek to have a recurrence interval of 1.1 years (based on data from the flow gauge far downstream at Wilcox.

The channel dimensions for the bankfull channel are summarized below in Table 2.2.1. The prototypical channel shape is also plotted together with a surveyed cross section located about 500 feet upstream of Comer Bridge to show that it is similar to the existing channel in shape.

Table 2.2.1 Recommended Stable Cross Section Dimensions for Calabazas Creek near Comer Debris Basin	
Bankfull Channel Width (Ft)	12
Bankfull Channel Cross-channel Slope, Horizontal:Vertical (Ft/ Ft)	2.5:1
Bankfull Channel Depth (Ft)	2.5
Flood Plain Slope, Vertical/Horizontal (Ft/Ft)	0.002
Bank Slope, Horizontal:Vertical (Ft/Ft)	2:1

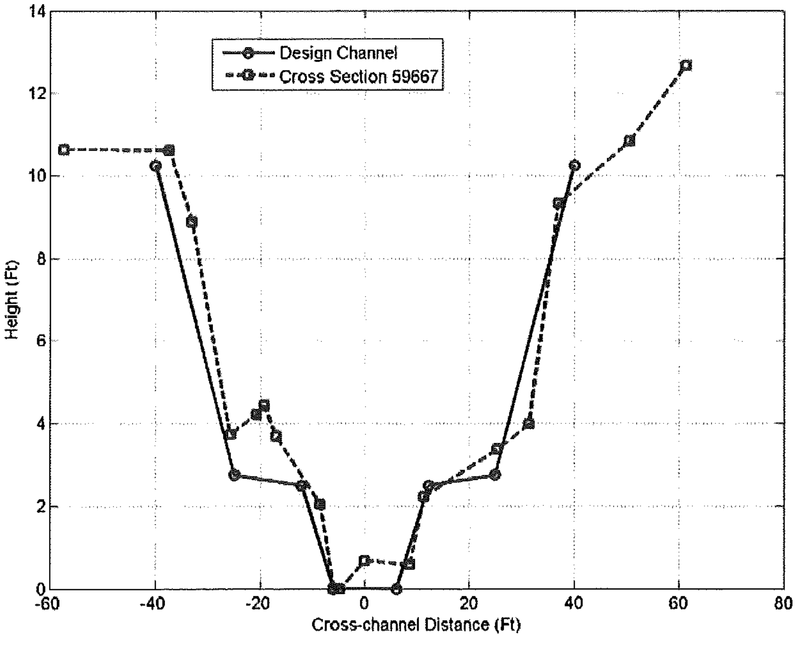


Figure 2.2.1 A channel cross section located about 500 feet upstream of Comer Dam superimposed on the design channel.

3. Feasible Design of Alternative I

The design for Alternative 1 involves complete removal of the Comer Debris Dam and its wingwalls. The channel profile would be modified to have a consistent, stable slope formed by a combination of excavation (primarily upstream of the dam) and fill (primarily downstream of the dam). Removal of the dam would significantly improve the habitat around Comer Debris Basin for establishment of vegetation and aquatic life, but these improvements would be initially offset by the large impact area necessary for its construction. The main purposes of Alternative I then are the improved flood protection at Comer Drive, which would be achieved by excavation under the bridge to a depth of at least 7 feet to provide the 100 year flood protection, and the improved habitat for aquatic life.

Design Parameters for Alternative I

The main design parameters for Alternative I are the depth of clearance beneath Comer Drive Bridge and the consistent channel slope. In the following analysis, we identify the most feasible channel slope which also provides the needed clearance below Comer Drive Bridge.

Of course, the channel shape and roughness also play a strong role in determining sediment transport capacity and are parameters which can be varied to achieve a stable design channel. For this analysis, it was deemed reasonable to use the prototypical stable and geomorphic channel identified for this area of Calabazas Creek as described in Section 1.1. This shape is used in the excavation of channel cross sections, with deviations from the design shape according to its ability to tie into the existing banks at some locations.

SAM Analysis

In this section, we describe the process for determining the most stable slope for alternative I.

The first step in this process involves making an educated guess of channel configuration which may be stable, which provides at least 7 feet of clearance beneath Comer Drive Bridge, and which attempts to minimize the impact area. The slope guess is necessary for the development of initial HEC-RAS geometry input, which is modified for each iteration of the SAM analysis (usually by changing the invert slope of the project reach).

The project reach for alternative 1 must extend both upstream and downstream of Comer Drive Bridge to allow for complete removal of the Dam. Its slope should be on the order of the slopes of the surrounding reaches. A slope of 1.5% with about 9 feet of clearance beneath Comer Drive Bridge was estimated to be a good first guess at a stable slope. This slope provides the necessary clearance under the bridge and has a relatively minimal impact area extending about 1110 feet downstream and 590 feet upstream of Comer Drive Bridge, so that it is situated between existing reaches 1 (downstream) and 4 (upstream). In addition, the project reach has quite a long stretch of channel for which the existing floodplain and channel shape is both wider and shallower than Reach 4 upstream. A steeper slope than that for Reach 4 of 1.3% is potentially called for in order to balance the sediment transport capacity upstream.

In order to perform the SAM analysis for the 1.5% slope channel case, hydraulically-uniform reaches for computing the average sediment transport capacity had to be identified. These were based on the reaches identified for the existing conditions case. As it turns out, the project reach for the 1.5% case includes all of reach 2 and most of reach 3. Thus, the choice of reaches was obvious- one for characterizing the project reach, Reach 1 shortened on its upstream end by about 300 feet for characterizing the downstream reach, and Reach 4 extended by about 300 feet on its downstream end for characterizing the upstream reach. These new Reach 1 and 4 definitions did not differ significantly in channel geometry or hydraulics from their definitions for the existing conditions case.

The results of the 1.5% case indicated that the slope choice of 1.5% was too large. Figures 3.1 and 3.2 show the sediment transport capacity and rating curve results from the SAM analysis. Although the transport capacity of the project reach is only about 6% larger than that of the reach upstream, it is also

40% larger than that of the downstream reach. This situation could lead to significant deposition downstream in Reach 1.

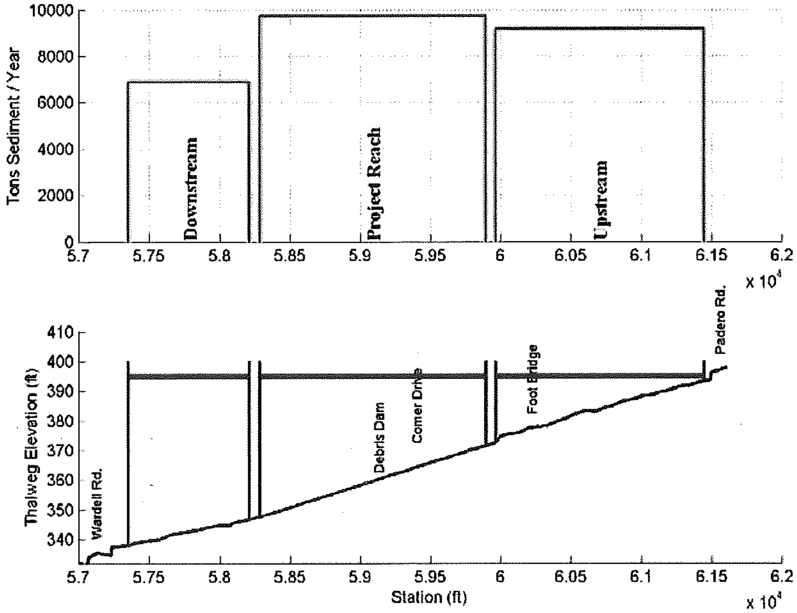


Figure 3.1 Sediment Transport Capacity Calculations for a version of Alternative I with a 1.5% invert slope.

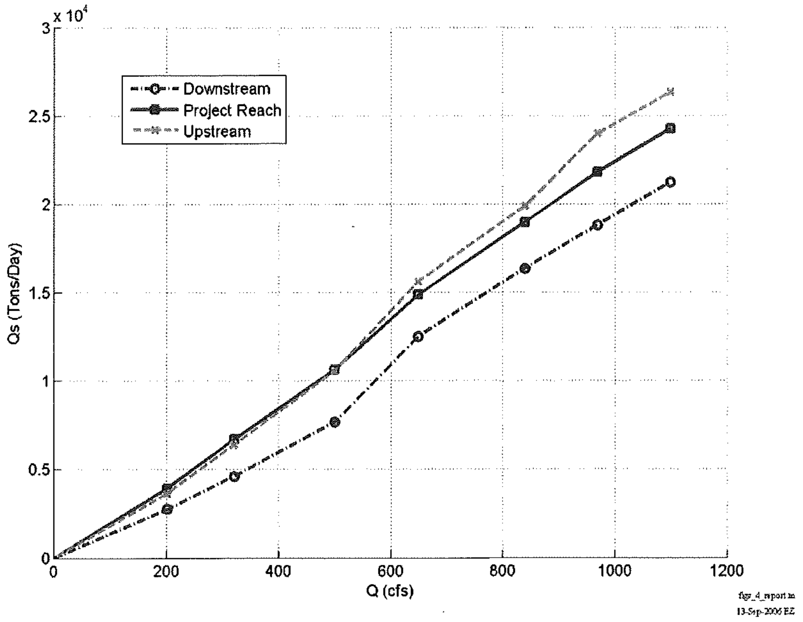


Figure 3.2 Sediment Rating Curves for a version of Alternative I with a 1.5% invert slope.

A more stable channel configuration for Alternative 1 should have a smaller slope, allowing for the transport capacity of the project reach to lie between the O(9000) tons/year of the reach upstream and O(5000) tons/year of the reach downstream. It would also have at least 7 feet of clearance and a minimal impact area. The impact area can be easily assessed by plotting lines of different slopes which go through the points below the bridge at fixed distances greater than or equal to 7 feet from the Comer Drive soffit. The upstream and downstream locations where these lines intersect with the existing thalweg profile (if they do at all) define the limits of impact. Figure 3.3 shows these lines for slopes with 1.2%, 1.3% and 1.4% for the 8 ft clearance case. Seven, nine, and ten feet clearance cases were also considered. The 1.3% slope case was deemed to be the most feasible (with a lower slope and reasonable impact distance) for 7 and 8 feet of clearance. The 8 ft clearance was selected because it provides extra freeboard.

For the 1.3%/ 8-ft of clearance case, the existing uniform reaches downstream and upstream of the proposed project reach are Reaches 0 and 4, respectively. The sediment transport capacities for these neighboring reaches are 5055 tons/year for Reach 0 and 9225 tons/year for Reach 4. Thus, the aim for the project reach should be to provide a transport capacity somewhere within this range.

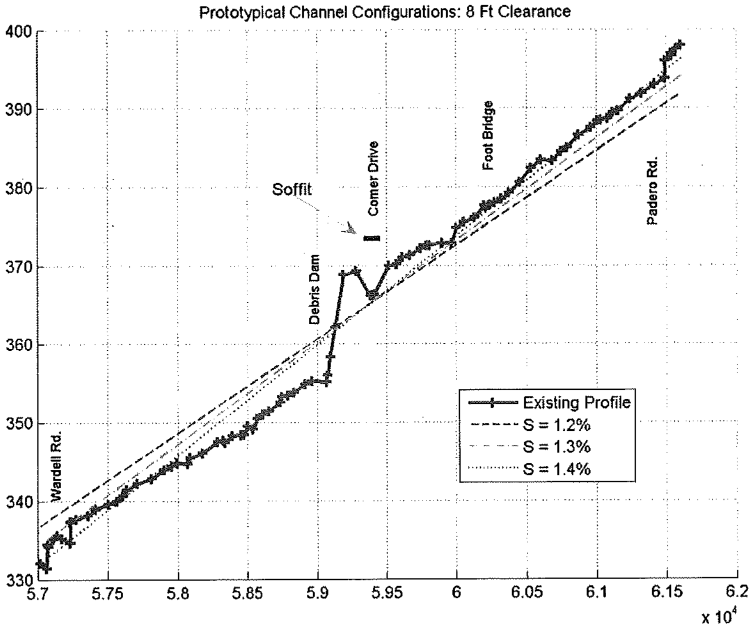


Figure 3.3 Constant-slope lines that go through the point 8 feet below the bridge opening plotted to show locations of their intersection with the existing thalweg profile.

In order to determine a preliminary estimate of the sediment transport capacity for this case, a HEC-RAS model was run with uniform channel cross sectional shape based on the design channel shape outlined above and a constant 1.3% slope, with normal depth boundary conditions specified on the downstream and upstream ends. The SAM analysis was then performed, and results estimated a sediment transport capacity for that reach of about 8630 tons/year. This capacity estimate value falls between those for Reaches 0 and 4, as required for the development of a stable channel. This estimate is very rough, however, because it does not take into account changes in geometry (e.g., in the width or floodplain) which occur over the length of the project reach.

Alternative 1 may be the least desirable of the three alternatives because it impacts the largest stretch of creek. In addition, preliminary calculations indicate that the sediment transport capacity of the project reach would be increased significantly relative to existing capacities computed for Reaches 1, 2 and 3 (as identified for the existing case). This is due to the fact that the large drop at the existing debris basin allows for milder slopes extending upstream and downstream of the dam than could exist if the drop were replaced with a consistently sloped channel invert. This increased transport would likely result in an eventual slope adjustment over years, most likely causing deposition downstream of the project reach.

If this alternative were to be adopted as the preferred one, it is highly recommended that a HEC-6 type analysis be performed to compute the long term bed evolution.

4. Feasible Design of Alternative 2

Alternative 2 involves removing the dam and wingwalls in their entirety, and replacing them with a series of small drops. This alternative impacts a smaller distance of about 750 feet of the creek than alternative 1, but also requires construction of the drops and the purchase of large rock for their construction.

The design of Alternative 2 includes 1) a channel realignment to straighten the channel slightly in the vicinity of Comer Dam, and 2) construction of 10 drops with the distance between drops ranging from 60 – 170 feet. The drops are located away from bends and the bridge entrance at Comer Drive; i.e., in reaches where the flow is relatively uniform. In addition, care will be taken to allow for preservation of the Oak tree near Comer Debris Dam. In construction, we assume that the drops themselves will be constructed of rock, and a rock-lined pool about 15 feet long will be constructed downstream of each drop. The portion of the channel bed between each drop which is natural will also be covered with an armoring layer similar to that which exists upstream of the dam, yielding similar roughness to the channel as the upstream. The channel shape is based on the design channel defined in section 1 above, where the design channel cross section will be positioned to tie into the existing banks and the bankfull channel will be centered around the new channel alignment.

In this case, the project reach containing the 10 drops was flanked by existing reaches 2 on the downstream end (almost all of it) and 3 on the upstream end (all of it), which have approximately equal sediment transport capacities. The project reach was divided into 9 different sub-reaches, each including 2 or more cross sections. These sub-reaches were located between adjacent drop structures and outside of the influence of drawdown on the downstream end where the flow goes critical. There is one fewer sub-reach than the number of drop structures because the areas downstream of the most downstream drop and upstream of the most upstream drop were absorbed into reaches 2 and 3. Reaches 1 and 4 of the existing channel were also included in this analysis. The values for Reach 0 are unchanged from the existing conditions case, and have been included in Table 4.1 below for reference (but not its accompanying Figure 4.1).

The initial geometry had a slope of 1.25% between drops, with drop heights constant at about 0.75 feet. This produced sediment transport capacities in the project reach which were about 10- 20% larger than the transport capacity immediately upstream and downstream of the reach (omitting the large transport capacity in the reach named Drop 7 - 8, see the next paragraph).. This could lead to significant erosion in the project reach. Therefore, the slope between drops was adjusted to the smaller value of 1% by changing the drop heights to range between 0.8 and 1.2 feet tall. [This was achieved efficiently in the HEC-RAS geometry file by translating entire sections up or down with a maximum elevation change of 1.2 feet]. The results of these two analyses are shown in Table 4.1 below. [Note that the transport capacities for Reaches 2 and 3 are slightly different values from those provided in the Table 2.1.4.1, but that values are the same for Reaches 0 and 4. In Reach 2, the difference is due to the slightly shortened reach definition. In Reach 3, the difference is due to the changed downstream flow conditions of the project reach (i.e., Alternative II).]

The goal is for the sediment transport capacities of existing reaches 2 and 3 (highlighted) to match those along each of the drops. For both cases, drop reach 7 - 8 has a much larger capacity than all other drops- this is due to the fact that the drop reach 7 - 8 goes beneath Comer Drive Bridge, which has a lower roughness value. The average transport capacities across drops (but excluding drop reach 7 - 8) are about 6496 tons/year and 7517 tons/year for the 1% slope and 1.25% slope cases, respectively. The 1% slope case average transport capacity is about 4% lower than the downstream capacity and 0.7% higher than the downstream capacity, whereas that for the 1.25% case is 11 to 15 percent higher than capacities of reaches 2 and 3.. Therefore, the 1% slope in the project reach should yield a more stable channel. The results for the 1% slope case are shown in Figures 4.1 and 4.2, showing the sediment transport capacity for each reach as a bar plot and the sediment rating curves developed for each reach as line plots.

The choice of the 1% slope also makes sense physically. As described in Table 1.2.1, Reach 3 has a smaller slope (1% vs. 1.3%), a less rough channel bottom (n ~ 0.034 vs n ~ 0.04), and a wider floodplain than Reach 2. Combined, these factors act to balance the sediment transport between Reaches 2 and 3—i.e., the smaller roughness (acting to increase channel velocity) combats the wider floodplain and smaller slope (acting to decrease channel velocity). With the sediment transport capacities of the reaches immediately upstream and downstream of the project reach balancing, the goal is to find a slope which yields the same transport capacity as that of those two reaches. In this case, since the design channel shape and roughness are dictated to be similar to that of the upstream reach, the obvious choice for the prototypical slope is about 1%. Figures 4.1 and 4.2 support this argument.

Table 4.1 Comparison of sediment transport capacities for two versions of Alternative 2 (1% and 1.25% slopes). Values are rounded to the nearest 5.

Reach Idenfication	Sediment Transport Capacity in tons/year	
	Alternative 2 with 1% Slope Between Drops	Alternative 2 with 1.25% Slope Between Drops
Reach 0	5055	5055
Reach 1, Existing Channel	5875	5875
Reach 2, Existing Channel	[redacted]	[redacted]
Drop 1-2, Project Reach	6410	7605
Drop 2-3, Project Reach	6755	8000
Drop 3-4, Project Reach	6495	7360
Drop 4-5, Project Reach	6470	7590
Drop 5-6, Project Reach	6155	7250
Drop 6-7, Project Reach	6870	7730
Drop 7-8, Project Reach	8240	9800
Drop 8-9, Project Reach	6125	7050
Drop 9-10, Project Reach	6685	7550
Reach 3, Existing Channel	[redacted]	[redacted]
Reach 4, Existing Channel	9225	9225

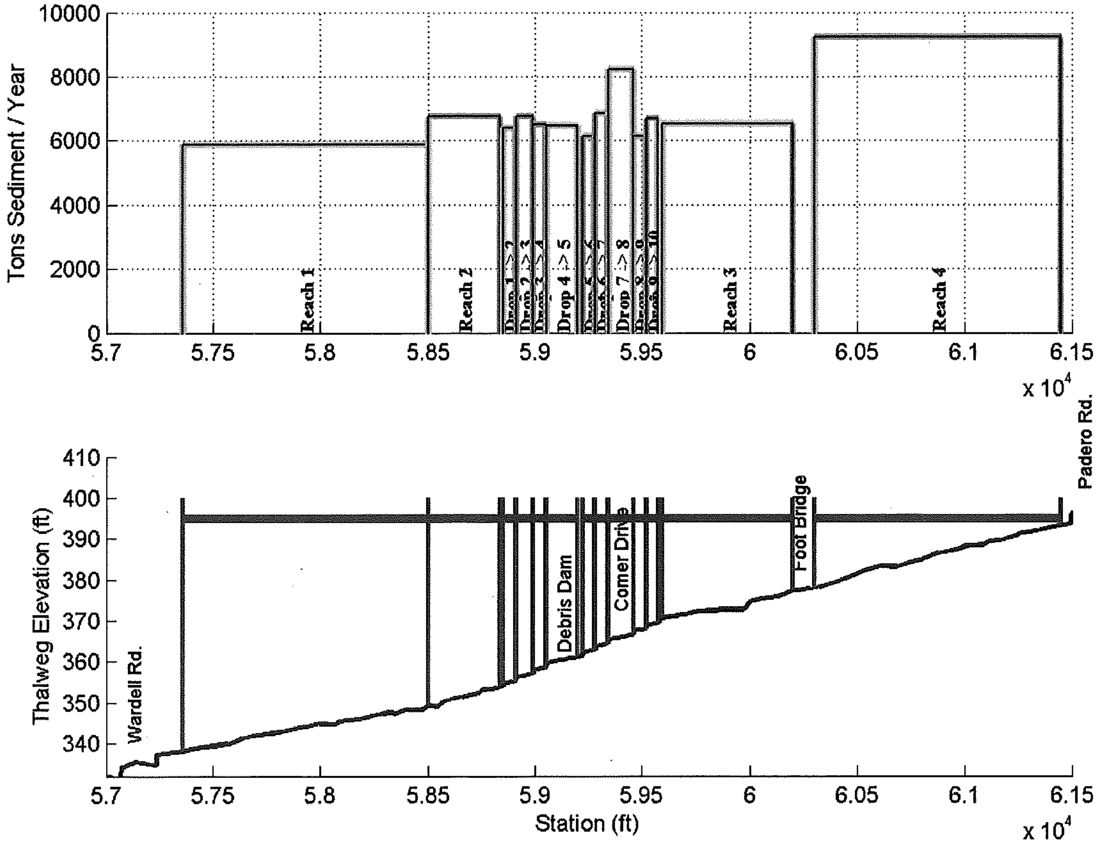


Figure 4.1 Average annual sediment transport capacity computed from 6 years of historical flow data, in tons/year (above), for Altrernative 2. Definition of reaches over which hydraulic parameters were averaged (below). The sediment gradation curve used in these calculations is shown above, in Figure 1.3.2.

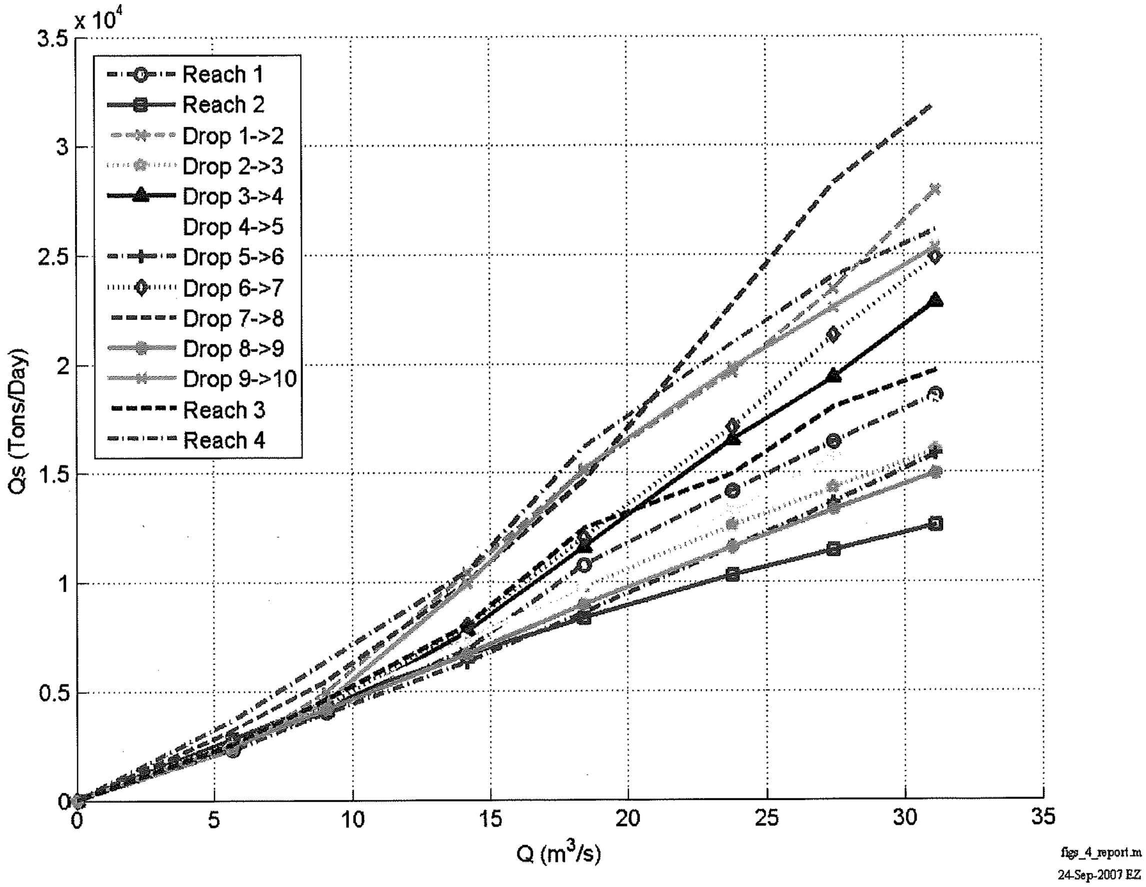


Figure 4.2 Rating curves computed with SAM, using hydraulic input from HEC-RAS and the sediment gradation curve shown in Figure 1.3.2, for the reaches in Alternative 2 with a 1% slope between drops.

5. Feasible Design of Alternative 3

Alternative 3 would partially remove Comer Debris Dam, lowering the existing drop to increase clearance beneath the bridge, but preserving its lower portion. The main benefit from construction of Alternative 3 would be the improved flood protection at Comer Drive Bridge. Secondary benefits would include a generally improved environment for the establishment of vegetation and for aquatic life. However, these secondary improvements would be to a lesser extent than those for Alternatives 1 or 2 because of the preserved steep drop.

Three geometry configurations were considered for Alternative 3. All versions of Alternative 3 extend from Comer Debris Dam about to a distance of about 175 feet upstream of Comer Drive Bridge, for a total impact distance of about 500 feet. The configurations tested for stability included three cases, called Alternative 3a, Alternative 3b and Alternative 3b1. Alternative 3a has a 1.5% slope case with removal of the top 8 feet of the dam (including a drop of 0.85 feet at the downstream end of Comer Drive Bridge). Alternative 3b has a 1 % slope with removal of the top 5.6 feet of the dam (with no drop). Alternative 3b1 has a 1.25% slope with removal of the top 6.4 feet of the dam (with no drop). All versions of Alternative 3 conform to the existing channel a distance of about 175 feet upstream of Comer Dr. Bridge. The channel slope between the downstream face of the bridge and the conforming point is about 1.7% for all three cases.

The HEC-RAS model results showed that the flow was close to critical depth upstream of the bridge. In order to determine whether this was due to the steep 1.7% slope there, some tests were performed by using a milder (1.25%) slope upstream of the bridge and conforming to the existing channel with a drop. The results of these tests indicated that the cause of the near-critical flow was due to changes in channel width, and not the slope.

Construction of alternatives 3a, 3b and 3b1 includes excavating sediment over the distance 175 feet upstream of the bridge to the downstream face of the bridge to form a uniform, 1.7% slope. This procedure would provide an additional three feet of clearance (for a total of seven feet of clearance) beneath the bridge. From the downstream face of the bridge, sediment would be further excavated with consistent slopes of 1% and 1.25%. The 1.5% case tested is different and would include an additional 0.85 ft drop at the downstream face of the bridge, downstream of which sediment would be excavated to form a uniform 1.5% slope.

Table 5.1 Average Annual Sediment Transport Capacity for Different Versions of Alternative 3. Values are rounded to the nearest 5.

	Average Annual Sediment Transport Capacity (tons/year): Alternative 3a (1.5% Slope)	Average Annual Sediment Transport Capacity (tons/year): Alternative 3b (1 % Slope)	Average Annual Sediment Transport Capacity (tons/year): Alternative 3b1 (1.25% slope)
Reach 1	5850	5845	5845
Reach 2	6550	6515	6515
Project Reach for Alternative 3	14310	5220	6625
Reach 3	7320	7310	7310
Reach 4	9185	9565	9565

The average annual sediment transport capacity results for the alternatives 3a, 3b and 3b1 are shown in table 5.1 above. Of the three versions of Alternative 3 tested, alternative 3b1 provides an acceptable sediment transport capacity for the project reach. The project reach capacity for alternative 3b1 is only about 2% larger than that downstream, and 9% smaller than that upstream. By contrast, the project reach capacity for the 1% slope is about 20% lower than that downstream and 29% lower than that upstream. The transport capacity for Alternative 3a is significantly higher than upstream or downstream, because the steep slope induces supercritical flow in the project reach for most flow rates. The reach layout and sediment transport capacity variation for Alternative 3b1 are shown graphically in figure 5.1 below. Because Alternative 3b1 is the most stable version of alternative 3, it will now be referred to simply as Alternative 3.

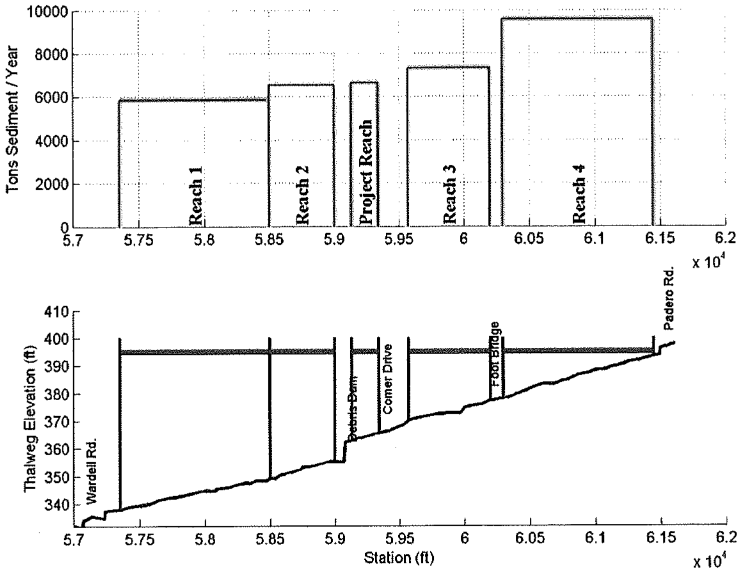


Figure 5.1. Average annual sediment transport capacity (computed with 6 years of flow data from 1999-2004) for Alternative 3 (version b1).

For this simple SAM analysis, it is important to investigate how the sediment transport rating curves (i.e., sediment transport rate vs. flow rate) vary between reaches in addition to a sediment transport capacity analysis. This second step is necessary because it always possible for average annual sediment transport capacities between two reaches to balance in cases where the sediment rating curves are quite different (e.g., the curves could cross).

The sediment transport rating curves for Alternative 3 are shown in Figure 5.2 below. The rating curves are very similar between reaches. The results presented in this figure close the loop, proving that the cause of the balanced sediment transport capacity values, is, indeed, the similarity in rating curves between neighboring reaches. Because the low flows are more frequent, it is particularly important that the rating curves match at lower flows (which they do).

The sediment transport of Reach 4 looks to be significantly higher than that of all reaches downstream. In the field, there is evidence of erosion in Reach 4, but it is localized and does not occur to the extent that would be expected from the differences in sediment transport capacity. From observations (from site visits) of relatively minimal erosion to the invert profile, it is likely that the actual amount of sediment transported in Reach 4 is significantly smaller than that of it downstream neighbor Reach 3.

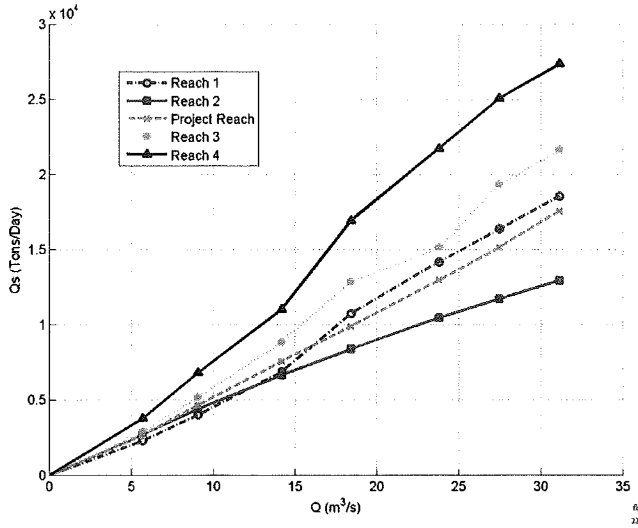


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Figure 5.2 Sediment transport rating curves developed for each reach for Alternative 3.

6. Summary

The results of the sediment transport analysis are summarized in Table 6.1 below.

Table 6.1 Summary of the sediment transport analysis for each alternative

	Alternative I	**Alternative II**	**Alternative III**
Extent of Impact Area	2700 Ft	750 Ft	500 Ft
Brief Description of the alternative geometry	Dam is completely replaced with a channel of consistent slope of about 1.3% or smaller.	Dam is replaced with a series of 10 drops of 0.8 – 1.2 feet high, with lengths between drops raning from 60 – 170 feet.	Top 5.6 feet of the dam is removed. Channel is excavated to have a consistent slope of 1.25% extending from the Dam to Comer Drive; of 1.7% extending from the Comer Drive to a

			distance 175 feet upstream to conform to the channel.
Level of Detail in Study	With its large impact area, a number of simplifying assumptions were used in the design of the prototypical stable channel geometry.	Final prototypical geometry design for Alternative II was detailed, robust, and stable.	Final prototypical geometry design for Alternative III was detailed, robust, and stable.
SAM Analysis Results	Alternative I can be stable, but details of stable channel geometry need to be flushed out for this alternative.	Alternative II is stable according to SAM analysis.	Alternative III is stable according to SAM analysis.

7. Recommendations

From an invert stability perspective, Alternatives II and III have been shown to be equally stable according to this steady-state SAM analysis. More work is required to design the stable geometry for Alternative I because of its large impact area, but it should be possible to do so. Once an alternative has been selected, a HEC-6 style model should be performed to ensure that the design geometry is stable as well.

From an impact area perspective, Alternative I has the largest impact area, followed by Alternatives II and III. Alternatives II has an impact area which is about 185 feet longer than Alternative III.

From an environmental and aesthetic perspective, Alternative II is probably preferred. Compared with Alternative III, it allows for better fish passage, entirely removes the dam, and has a reasonable impact area. Compared with Alternative I, its impact area is much smaller. Alternative I may eventually provide the same environmental benefit as Alternative II after the vegetation in the creek has re-established itself, and would provide easier fish passage than Alternative II, due to its lack of drop structures.

From a cost perspective, Alternative II is probably more costly than Alternative III because it involves more earth, the additional construction of step-pools (incurring both labor and rock materials costs), and the complete (as opposed to partial) removal of Comer Debris basin. The costs of Alternatives I and II cannot be easily compared until estimates have been completed. Both involve complete removal of the Dam. Alternative I requires more earth work than Alternative II, but Alternative II requires construction of drop structures (including labor and rock materials costs) whereas Alternative I lacks drop structures.

The results of this study are focused mainly on the channel invert stability and should be combined with the results of the geomorphology studies before choosing the preferred alternative.

8. References

Kennedy/Jenks Consultants, 2002. "Comer Debris Basin Engineering Feasibility Study Final Reaport," prepared for Santa Clara Valley Water District.

Philip Williams and Associates, 2005. "Santa Clara Valley Water District (SCVWD) Stewardship Initiative: Calabazas Creek Tier One Fine-Scale Geomorphic Assessment," prepared for Tetra Tech.